

Timer/Counter/ Analyzers

PM6681, PM6681R & PM6681R/676/AF

Service Manual

FLUKE®

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GENERAL INFORMATION

This manual contains directions for use that apply to a number of models. In order to simplify references to certain models, the following designation system is used throughout the manual:

PM6681 stands for PM6681, PM6681R and PM6681R/676/AF

PM6681R stands for PM6681R and PM6681R/676/AF

The PM6681R/676/AF is a model supplied with the following features:

- PM6681R base model
- Prescaler PM9624 (2.7 GHz)
- Rackmount kit PM9622
- Reference output option PM9671B

Refer to the respective type numbers in the Operators Manual for specifications and other information not found in this manual.

New options and deviations from the original design are collectively treated in Chapter 9, Appendix. Below is a summary of the changes:

Unit 1

The main printed-circuit board (Unit 1) has recently been redesigned due to obsolescence of a number of integrated circuits. Designations found in circuit descriptions, schematic diagrams and parts lists in the first eight chapters refer to the original design. The functional descriptions are correct on the whole, if you make a few substitutions. A new set of schematic diagrams and a new replacement parts list are added in Chapter 9, Appendix.

- Instruments having serial numbers >784919 belong to the new generation.
- The model PM6681R/676/AF has only been produced with the new Unit 1 board, so the serial number is irrelevant.

Model PM6681R

The model PM6681R introduces an ultra-stable rubidium atomic clock reference.

Option PM9671B

Reference output unit offering six buffered 1 V_{rms} outputs with four different standard frequencies: 3 x 10 MHz, 1 x 5 MHz, 1 x 1 MHz and 1 x 0.1 MHz.

New OCXOs

The PM9691 has been redesigned, and a version with very high stability, the PM9692, has been introduced.

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Safety Instructions

WARNING: These servicing instructions are for use by qualified personnel only. To reduce the risk of electric shock, do not perform any servicing other than that specified in the Operating Manual unless you are fully qualified to do so.

Authorized service and calibration of this instrument is available worldwide. A list of service centers is printed on the last page of this manual.

Read this chapter carefully before you check, adjust or repair an instrument.

Caution and Warning Statements

You will find specific warning and caution statements where necessary throughout the manual.

CAUTION: Indicates where incorrect operating procedures can cause damage to, or destruction of, equipment or other property.

WARNING: Indicates a potential danger that requires correct procedures or practices in order to prevent personal injury.

This Timer/Counter has been designed and tested in accordance with safety class 1 requirements for Electronic Measuring Apparatus of IEC publication 1010-1, and CSA C22.2 No.231, and has been supplied in a safe condition.

This manual contains information and warnings that should be followed by the user and the service technician to ensure safe operation and repair in order to keep the instrument in a safe condition.

WARNING: The opening of covers or removal of parts, except those to which access can be gained by hand, is likely to expose live parts and accessible terminals which can cause death.

The instrument must be disconnected from all voltage sources before it is opened. Remember that the capacitors inside the instrument retain their charge even if the instrument has been disconnected from all voltage sources.

Grounding

This instrument is connected to ground via a sealed three-core power cable, which must be plugged into socket outlets with protective ground contacts. No other method of grounding is permitted for this instrument.

The ground symbol on the rear panel indicates where the protective ground lead is connected inside the instrument. Never remove or loosen this screw.



When the instrument is brought from a cold to a warm environment, condensation may cause hazardous conditions. Therefore, ensure that the grounding requirements are strictly met.

Power extension cables must always have a protective ground conductor.

Indicates that the operator should consult the manual.



WARNING: Any interruption of the protective

ground conductor inside or outside the instrument, or disconnection of the protective ground terminal, is likely to make the instrument dangerous. Do not intentionally disrupt the protective grounding.

Disposal of Hazardous Materials

WARNING: Disposal of lithium batteries requires special attention. Do not expose the batteries to heat or put them under extensive pressure. These measures may cause the batteries to explode.

A lithium battery is used to power the non volatile RAM in this instrument. Our world suffers from pollution, so don't throw batteries into your wastebasket. Return used batteries to your supplier or to the Philips or Fluke organization in your country.

Line Voltage

The Timer/Counter can be powered by any voltage between 90 and 265 VAC without any range switching. This makes it suitable for all nominal line voltages between 100 and 240 V.

• Replacing Components in Primary Circuits

Components that are important for the safety of this instrument may only be replaced by components obtained from your local Philips or Fluke organization. After exchange of the primary circuits, perform the safety inspection and tests, as described in Chapter 5, "Repair".

• Fuses

This instrument is protected by an ordinary 1.6 A slow blow fuse mounted inside the instrument. NEVER replace this fuse without first examining the Power Supply Unit.

Chapter 2

Performance Check

General Information

WARNING: Before turning on the instrument, ensure that it has been installed in accordance with the Installation Instructions outlined in Chapter 1 of the Operators Manual.

This performance procedure is intended to:

- Check the instrument's specification.
- Be used for incoming inspection to determine the acceptability of newly purchased instruments and recently recalibrated instruments.
- Check the necessity of re calibration after the specified recalibration intervals.

NOTE: The procedure does not check every facet of the instrument's calibration; rather, it is concerned primarily with those parts of the instrument which are essential for determining the function of the instrument.

It is not necessary to remove the cover of the instrument to perform this procedure.

If the test is started less than 20 minutes after turning on the instrument, results may be out of specification, due to insufficient warm-up time.

Required Test Equipment

| Type of instrument | Required Specifications | Suggested Instrument |
|--------------------------|--|---|
| LF Synthesizer | Square; Sine up to 2 MHz | PM5193 |
| Digital Multimeter | to 300 V _{AC} & V _{DC} | PM2518; Fluke 77 |
| Power Splitter | | PM9584/02 |
| T-piece | | PM9067; Y9107 |
| Termination | 50 Ω | PM9585; Y9103 |
| Low pass filter | 50 kHz | PM9665B/01 |
| Reference oscillator | 10MHz 1*10 ⁻⁸ for 01 to 04 oscillator 5MHz 1*10 ⁻¹⁰ for 05 osc. | Philips counter with calibrated PM9691 PM 6685R *) |
| HF signal generator | to 2.1 GHz for PM9621, 5 GHz for PM9624 & 25 | Fluke 6062A Wilton 6717B-20 (*) |
| Pulse Generator | to 125 MHz | PM5786B; PM5781 |
| Oscilloscope with probes | 350 MHz | PM3295 |
| Power Supply | min 40 V _{DC} | PM2811/113, PE1537; PE1542 |
| BNC-cables | 5 to 7 cables | |

Table 2-1 Recommended Test Equipment

*) This test equipment is needed if an option is installed.

Preparations

Power up your instruments at least 20 minutes before checking to let them reach normal operating temperature. Failure to do so may result in certain test steps not meeting equipment specifications.



Front Panel Controls

Power-On Test

At power-on the timer/counter performs an automatic self-test of the following:

- Microprocessor
- RAM
- ROM
- Measuring circuits

It also displays the GPIB address.

If there are any test failures, an error message is shown.

Internal Self-Tests

The built-in test programs from the power-on test can also be activated from the front panel as follows:

- Enter the Auxiliary Menu by pressing **AUX MENU**.
- Select the test submenu by pressing **SELECT** up or down.
- Enter the test menu by pressing the **ENTER** key.

Selections for internal self-tests are:

- 1 TEST RO (ROM)
- 2 TEST RA (RAM)
- 3 TEST ASIC (Measuring Logic)
- 4 TEST DISP (Display Test)
- 5 TEST ALL (Test 1 to 4 in sequence)

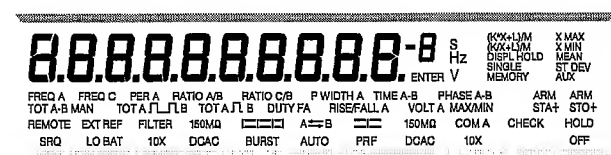


Figure 2-1 Text on the display

- Use **SELECT/SET** to select TEST ALL, then press **ENTER**.
- If any fault is detected, an error message appears on the display and the program halts.
- If no faults are detected, the program returns to measuring mode.

Keyboard Test

This test verifies that the *timer/counter* responds when you press any key. To check the function behind the keys, see the tests further on in this chapter.

Press the keys as described in the left column and look on the display for the text, as described in the second column. Some keys change more text on the display than described here. The display text mentioned here is the text mostly associated with the selected key.

NOTE: For the instrument to respond correctly, this test must be carried out in sequence and you must start with the Preset setting.

| Key(s) | Display | Pass /Fail | Note |
|----------------------|---------------------------|------------|---------------------------|
| STAND-BY | Display Off | | Red LED beside the key On |
| ON | ----- | | Backlight on |
| PRESET | preset ----- | | Default setting |
| EXT REF | EXT REF | | |
| Input A | | | |
| FILTER | FILTER | | |
| 50Ω/1MΩ | 50 Ω | | |
| / I \ | \ | | |
| AC/DC | DC | | |
| AUTO | 1X | | |
| 1X/10X | 10X | | |
| SET A 1 . 7 3 | 1.73 V Enter | | |
| ENTER | ----- | | |
| SWAP A ↔ B | A ↔ B | | |
| Input B | | | |
| / I \ | \ | | |
| 50Ω/1MΩ | 50 Ω | | |
| SET B 0 . 9 | | | |
| 8 +/- | -0.98 V Enter | | |
| ENTER | ----- | | |
| AC/DC | AC | | |
| 1X/10X | 10X | | |
| COM A | COM A | | |
| HOLD OFF ON | HOLD OFF | | |
| HOLD OFF SET | Hoff ti. | | |
| PRESET | ----- | | |
| Other | | | |
| TIME | 200 ⁻³ s | | |
| SELECT ▲ | 500 ⁻³ s | | |
| ENTER | ----- | | |
| HOLD | DISPL HOLD | | |
| HOLD | | | |
| SINGLE | SINGLE | | |
| FUNCTION ◀ | VOLT A _{MAX/MIN} | | |
| FUNCTION ◀ | RISE/FALL A | | |
| FUNCTION ▶ | VOLT A _{MAX/MIN} | | |
| FUNCTION ▶ | FREQ A | | |
| AUX MENU | Addr. | | |

| Key(s) | Display | Pass /Fail | Note |
|-----------------------------|--|------------|-----------------|
| RESTART | ----- | | |
| START ARM | Ar.Sta OFF | | |
| RESTART | ----- | | |
| STOP ARM | Ar.St0 OFF | | |
| RESTART | ----- | | |
| PRESET | preset ----- | | |
| CHECK | 100 000 0000 ⁶ * | | Start counting |
| MATH SELECT ▼ ENTER | Arith OFF Arith ON 100 000 0000 ⁶ * | | |
| K= 2 | 10 2 | | |
| ENTER | 200 000 0000 ⁶ * | | Counting |
| L= Xn-1 ENTER | 00 n-1 300 000 0000 ⁶ * | | Counting |
| L= | n-1 | | |
| 0 ENTER | 200 000 0000 ⁶ * | | Counting |
| L= Xo ENTER | 400 000 0000 ⁶ * | | Counting |
| L= | 200 000 0000 ⁶ * | | |
| 4 EE 7 ENTER | 240 000 0000 ⁶ * | | Counting |
| M= . 5 | 05 | | |
| ENTER | 480 000 0000 ⁶ * | | Counting |
| STAT | Stat. OFF | | |
| ENTER | 480 000 0000 ⁶ * | | Counting |
| FUNCTION ◀ (6 times) | TOT A-B MAN | | |
| TOT St/St | Gate LED lit | | |
| MENU | Displays all available functions, processes and input controls. Selected items are blinking. | | |
| PRESET | ----- ** | | Default setting |

Table 2-2 Keyboard test.

* The LSD digit may vary.

** MENU is not disabled by setting DEFAULT, press menu again.

Short Form Specification Test

Sensitivity and Frequency Range

- Press the **PRESET** key to set the *timer/counter* in the default setting.
- Select 50 Ω input impedance and Non AUTO, (X1).
- Connect a signal from a HF generator to a BNC power splitter.
- Connect the power splitter to your counter and an oscilloscope.
- Set input impedance to 50 Ω on the oscilloscope.
- Adjust the amplitude according to the following table. Read the level on the oscilloscope. The *timer/counter* should display the correct frequency.

| Frequency MHz | Level | | | Pass/Fail | |
|------------------|------------------|-------------------|-----|-----------|---------------------|
| | mV _{PP} | mV _{RMS} | dBm | Input A | Input B |
| 1 | 57 | 20 | -21 | | |
| 50 | 57 | 20 | -21 | | |
| 100 | 57 | 20 | -21 | | |
| 200 | 85 | 30 | -17 | | Channel-B 100MHz |
| 250 | 113 | 40 | -15 | | |
| 300 | 170 | 60 | -11 | | |

Table 2-3 Sensitivity for A & B inputs at various frequencies

- Connect the signal to input B.
- Select 50 Ω input impedance and SWAP A \leftrightarrow B on the counter.
- Repeat the above measurements for input B.

Check VMAX/VMIN

Check DAC for trigger level settings.

- Set your *timer/counter* in default setting by pressing **PRESET**.
- Select DC coupling, 1 M Ω input impedance and VOLT A MAX/MIN, but do not connect any input signal.
- The counter should now indicate:
 $V_{MAX} = 0 \pm 0.004V$ and $V_{MIN} = 0 \pm 0.004V$.
- Connect a 4.00 V_{DC} level to channel A, using an external low pass filter on the input.
- The readings should be:
 $V_{MAX} = 4.000 \pm 0.044V$, $V_{MIN} = 4.000 \pm 0.044V$.
- Change the DC level to 40V.
- The counter should indicate:
 $V_{MAX} = 40.0 \pm 0.84V$, $V_{MIN} = 40.0 \pm 0.84V$.
- Repeat the measurement with inverted polarity.
- Press MATH and select (K*X+L)/M to change to Vpp measurements.
- Press ENTER.
- Connect a sinusoidal signal to channel A with an amplitude 4.00 V_{PP} and a frequency of 100 kHz.
- The indication should be $4.00 \pm 0.244V$.
- Change the amplitude to 18 V_{PP}.
- The display should read $18.0 \pm 1.84V$.
- Select SWAP A \leftrightarrow B, and connect the signal to channel B. Repeat the measurements for B as described above.

Trigger Indicators and Controls

NOTE: This test must be performed in the sequence given.

- Press the **PRESET** key to set the Timer/ Counter in the default setting.
- Select Non AUTO, X1 attenuation, and 1 M Ω input impedance for channel A.
- Connect the following signal to channel A:
Sine, 10 kHz, 0.9 V_{PP}, and + 0.50 V_{DC}.
- Verify that the three modes for the trigger indicator are working properly by changing the trigger level:
 - Press the **SET A** key and enter 1 via the keyboard, then verify by pressing **ENTER**. Check the trigger indicator according to Table 2-4.
 - Press the **SET A** key and enter -1 via the keyboard, then verify by pressing **ENTER**. Check the trigger indicator according to Table 2-4.
 - Press the **SET A** key and enter 0 via the keyboard, then verify by pressing **ENTER**. Check the trigger indicator according to Table 2-4.

| Manually set trigger level | Trigger indicator | Pass/Fail | |
|----------------------------|-------------------|-----------|---------|
| | | Input A | Input B |
| +1 V | off | | |
| -1 V | on | | |
| 0.0 V | blinking | | |

Table 2-4 Trigger indicator check

- Select SWAP A \leftrightarrow B, and AC coupling on channel B, and repeat the exercise for channel B.

Trigger level check

- Deselect SWAP A \leftrightarrow B, connect the generator to channel A and check the trigger settings and indicators according to Table 2-5.

| Trigger setting | Trigger indicator | Pass/Fail | |
|--------------------------------------|-------------------|-----------|---------|
| | | Input A | Input B |
| SET A = 0 V | blinking | | |
| DC coupling | on | | |
| SET A = 0.7 V | blinking | | |
| 50 Ω Impedance | off | | |
| SET A = 0.2 V | blinking | | |
| AC coupling & 1 M Ω Impedance | blinking | | |
| X10 Attenuation | off | | |
| SET A = 0.0 V | blinking | | |
| X1 Attenuation | blinking | | |

Table 2-5 Trigger level check

- Select A \leftrightarrow B
- Connect the signal to channel B.
- Select AC coupling on channel B, and repeat the previous settings for channel B.
- Connect the signal to channel A.
- Only the trigger indicator for channel A should be blinking.
- Press **COM A**.
- Both indicators should be blinking.
- Connect the signal to channel B.
- No trigger indicator should be blinking.

Reference Oscillators

X-tal oscillators are affected by a number of external conditions like ambient temperature and supply voltage but also by ageing. Therefore it is hard to give limits for the allowed frequency deviation. The user himself must decide the limits depending on his application, and recalibrate the oscillator accordingly. See the Preventive Maintenance chapter.

| Oscillator | Max temperature dependence | Max ageing month | Max ageing year |
|--------------|----------------------------|------------------|-----------------|
| Standard, 01 | ± 100 Hz | ± 5 Hz | ± 50 Hz |
| PM 9678B, 02 | ± 10 Hz | ± 1 Hz | ± 5 Hz |
| PM 9690, 04 | ± 0.15 Hz | ± 0.2 Hz | ± 1 Hz |
| PM 9691, 05 | ± 0.05 Hz | ± 0.1 Hz | ± 0.75 Hz |

Table 2-6 Deviation (for PM 9690 and PM 9691 after 48 hours warm up time)

To check the accuracy of the oscillator you must have a calibrated reference signal that is at least five times as stable as the oscillator that you are testing, see the following table. If you use a non 10 MHz reference, you can use the mathematics in PM 6681 to multiply the reading.

- Set the counter to default settings by pressing **PRESET**.
- Connect the reference to input A
- Check the readout against the accuracy requirements of your application.

• Acceptance Test

As an acceptance test the following table gives a worst case figure after 30 minutes warm up time. All deviations that can occur in a year are added together.

| Oscillator | Frequency readout | Suitable reference | Pass /Fail |
|--------------|---------------------------------|--------------------|------------|
| Standard, 01 | 10.00000000 MHz ± 150 Hz | PM 9678B | |
| PM 9678B, 02 | 10.00000000 MHz ± 15 Hz | PM 9690 | |
| PM 9690, 04 | 10.00000000 MHz ± 2 Hz | PM 6685B | |
| PM 9691, 05 | 10.00000000 MHz ± 1 Hz | PM 6685B | |

Table 2-7 Acceptance test for oscillators

Resolution Test

- Connect a pulse generator to a power splitter.
- Connect one side of the power splitter to the A input of the counter via a coaxial cable.
- Connect the other side of the power splitter to the B input of the counter.

Settings for the *pulse generator*:

- Amplitude = 1 V_{PP}, (high level +1V and low level 0V)
- Period approximately 1 μ s
- Duration = approximately 50 ns
- Rise time 2 ns

Settings for the *timer/counter*, after Preset:

- Function = Time A-B
- Single

- Press **STAT** key under PROCESS
- Press **SELECT** key until display show 'ST DEV'.
- Meas Time = 50 μ s
- A and B inputs:
 - 50 Ω input impedance
 - Non AUTO
 - Trigger level = 0.5V
 - DC coupling

The result should be (std dev) < 0.05⁻⁹ s.

Rear Input/Output

10 MHz OUT

- Connect an oscilloscope to the 10 MHz output on the rear of the counter. Use coaxial cable and 50 Ω termination.
- The output voltage is sine wave shaped and should be above 500 mV rms (1.4 V p-p).

GATE OPEN Output

- Set your *timer/counter* in Default setting by pressing the **PRESET**.
- Select CHECK, Non AUTO, and Meas Time = 5 ms.
- Connect the oscilloscope to the Gate Open output via a coaxial cable. Set the oscilloscope to 1ms/division.
- The Gate Monitor output should be a pulse similar to the Figure 2-2 .

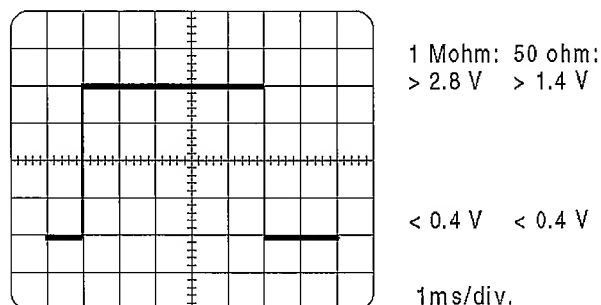


Figure 2-2 Signal on gate open output

REFERENCE IN

- Set the counter to Default Setting by pressing **PRESET**.
- Connect EXT REF out from another counter to input A.
- Connect a 10 MHz ± 100 Hz, 200 mV rms, (0.57 V p-p) signal to EXT REF IN at the rear, terminated with 50 Ω .
- Select Ext Ref.
- The display should show 10 MHz.
- Change the input frequency to 5, 2, and 1 MHz respectively.
- The display should still show 10 MHz.

EXT ARM input

- Select non AUTO.
- Settings for pulse generator: single shot pulse, amplitude TTL = 0 - 2 V_{PP}, and duration = 10 ns.
- Connect a pulse generator to EXT ARM input.
- Press **START ARM** key.
- Press **SELECT** key until display shows 'POS', confirm with **ENTER** key three times.
- The counter does not measure.
- Apply one single pulse to EXT ARM input.
- The counter measures once and shows 10 MHz on the display.

TRIG LEVEL A&B Outputs

- Press the **PRESET** key, to set the *timer/counter* in the default setting.
- Connect a voltmeter to TRIG LEVEL A(B) OUT at the rear.
- Set the Trigger Level (SET A/B) on the front to the following values, and verify the voltmeter's readout:

| SET A(B) | Readout | Pass/Fail | |
|----------|---------------|-----------|---------|
| | | Input A | Input B |
| + 5.00 V | + 5 V ± 0.28V | | |
| – 5.00 V | – 5 V ± 0.28V | | |
| 0.00 V | 0 V ± 0.03V | | |

Table 2-8 Trigger level outputs check

Probe Comp View

- Press the **PRESET** key to set the *timer/counter* in default setting.

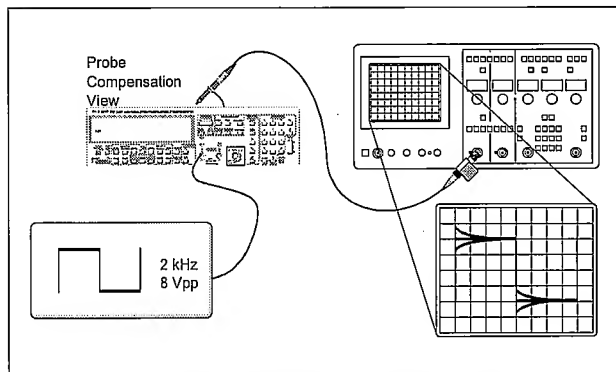


Figure 2-3 Adjustment of the counters probe.

- Select TIME A-B, non AUTO, X1 attenuation and DC coupling for both channels.
- Set the LF synthesizer to 2 kHz square wave and 8 V_{PP} amplitude.
- Connect synthesizer to Input A via a BNC-cable.
- Use an oscilloscope to check the signal at Probe Comp View, at the rear. The square wave will have the same step response and 4 V_{PP} amplitude.
- Select X10 attenuation.
- Check that the square wave is 2 kHz and 0.4 V_{PP}.
- Repeat this test for channel B.

Measuring Functions

Preparation for Check of Measuring Function:

- Press the **PRESET** key, to set the *timer/counter* in the default setting.
- Connect a 10 MHz sine wave signal with 2.0 V_{PP} amplitude to Input A.

Select the following settings for the *timer/counter*:

- 50 Ω input impedance for A and B
- Non AUTO
- COM A
- Check that the *timer/counter* performs the correct measurement, by displaying the result as shown under the "Display" column in Table 2-9.

| Selected Function | Action | Display | Pass/Fail |
|-------------------------|-----------------------|---|-----------|
| FREQ A | | 10 MHz ²⁾ | |
| FREQ C | | ----- 3) | |
| PER A | | 1 0 0 ⁻⁹ s ²⁾ | |
| RATIO A/B | | 1 0 0 0 0 0 0 0 | |
| | Select NEG SLOPE B | 1 0 0 0 0 0 0 0 | |
| RATIO C/B | | 0 0 0 0 0 0 0 0 | |
| PWIDTH A | | 5 0 0 0 0 ⁻⁹ s ¹⁾ | |
| TIME A-B | | 5 0 0 0 0 ⁻⁹ s ¹⁾ | |
| PHASE A-B | | 180 or -180 ¹⁾ | |
| TOT A-B MAN | | 0 | |
| | Deselect COM A | 0 | |
| TOT ST/STOP | | counting | |
| TOT ST/STOP | | stop counting | |
| | Select COM A | 0 | |
| TOT A B | | 1 | |
| TOT A B | | 1 | |
| | Select POS SLOPE B | 0 | |
| DUTY F A | | 0 5 0 0 0 0 0 ¹⁾ | |
| | Select AUTO | 0 5 0 0 0 0 0 ¹⁾ | |
| RISE/FALL A | | 3 0 0 0 0 ⁻⁹ s ²⁾ | |
| VOLT MAX/MIN | | +1 0 0 0 -1 0 0 0 V ²⁾ | |

Table 2-9 Measuring functions check

- 1) Value depends on the symmetry of the signal.
- 2) Exact value depends on input signal.
- 3) If an C-option is installed.

Check on HOLD OFF function

Press **PRESET** on the *timer/counter*.

Select the following settings for the *timer/counter*:

- Press **CHECK**.
- Select **PER A**.
- The counter should show 10^{-9} s*.
- Select **HOLD OFF**.
- The counter should show 1^{-6} s*.
- Set the Hold off time to 500^{-9} s.
- The counter should show 500^{-9} s*.

* The LSD digits may vary.

Options

Check on Prescalers

To verify the specification of the HF inputs in the instrument, perform the measurements below.

• PM 9621

| Required Test Equipment | Suggested instrument |
|-------------------------|----------------------|
| HF signal generator | Fluke 6062A |

Table 2-10 Test equipment for 1.3 GHz HF-input

- Connect the output of the signal generator to the HF input of the counter.
 - Connect the 10 MHz REFERENCE OUT of the generator to the REFERENCE IN at the rear panel of the counter.
- Setting for the *timer/counter* after Preset.
- Function = FREQ C.
 - EXT REF.

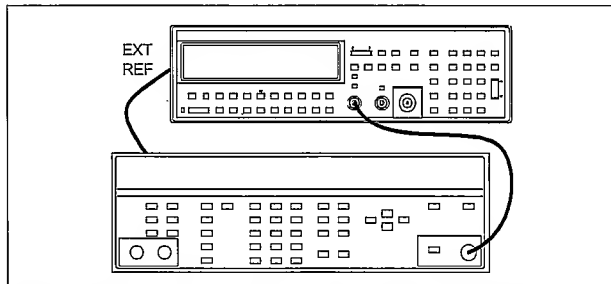


Figure 2-4 Connect the output of the signal generator to the HF-input of the counter.

- Generate a sine wave in accordance with the corresponding table below.

| Frequency | Amplitude | | Pass/Fail |
|-----------|-------------------|-----|-----------|
| MHz | mV _{RMS} | dBm | |
| 70-900 | 10 | -27 | |
| -1100 | 15 | -23 | |
| -1300 | 40 | -15 | |

Table 2-11 Sensitivity of PM 9621

- Verify that the counter counts correctly. (The last digit will be unstable).

• PM 9624, PM 9625B, or PM 9625

| Required Test Equipment | Suggested instrument |
|-------------------------|----------------------|
| HF signal generator | Wiltron 6717B-20 |

Table 2-12 Test equipment for 2.7, 4.2, and 4.5 GHz HF-inputs

- Connect the output of the signal generator to the HF input of the counter.
 - Connect the 10 MHz REFERENCE OUT of the generator to the REFERENCE IN at the rear panel of the counter.
- Setting for the *timer/counter* after Preset.
- Function = FREQ C.
 - EXT REF.

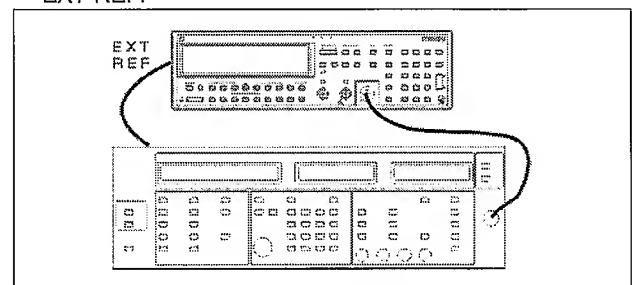


Figure 2-5 Connect the output of the signal generator to the HF-input of the counter.

- Generate a sine wave in accordance with the corresponding tables below.

| Frequency | Amplitude | | Pass/Fail |
|-----------|-------------------|-----|-----------|
| MHz | mV _{RMS} | dBm | |
| 100-300 | 20 | -21 | |
| -2500 | 10 | -27 | |
| -2700 | 20 | -21 | |

Table 2-13 Sensitivity of PM 9624.

| Frequency | Amplitude | | Pass/Fail |
|-----------|-------------------|-------|-----------|
| MHz | mV _{RMS} | dBm | |
| 150-300 | 20 | -21 | |
| -2200 | 10 | -27 | |
| -3500 | 15 | -23.5 | |
| -4200 | 25 | -19 | |

Table 2-14 Sensitivity of PM 9625B.

| Frequency | Amplitude | | Pass/Fail |
|-----------|-------------------|-------|-----------|
| MHz | mV _{RMS} | dBm | |
| 150-300 | 20 | -21 | |
| -2500 | 10 | -27 | |
| -3500 | 15 | -23.5 | |
| -4200 | 25 | -19 | |
| -4500 | 50 | -13 | |

Table 2-15 Sensitivity of PM 9625.

- Verify that the counter counts correctly. (The last digit will be unstable).

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PM 6681 Performance Check Report

| Power-On Test (page 2-2) | Pass | Fail |
|-----------------------------|------|------|
| | | |

| Internal Self-tests (page 2-2) | Pass | Fail |
|-----------------------------------|------|------|
| | | |

| Keyboard Test (page 2-3) | | | |
|-----------------------------|---------------|------|------|
| Key(s) | Display | Pass | Fail |
| STAND-BY | Display Off | | |
| ON | ----- | | |
| PRESET | PrESet | | |
| EXT REF | EXT REF | | |
| Input A | | | |
| FILTER | FILTER | | |
| 50 Ω /1M Ω | 50 Ω | | |
| / \ | \ | | |
| AC&DC | DC | | |
| AUTO | 1X | | |
| 1X/10X | 10X10X | | |
| SET A 1 . 7 3 | 1.73 V Enter | | |
| ENTER | ----- | | |
| SWAP A < > B | A B | | |
| Input B | | | |
| / \ | \ | | |
| 50 Ω /1M Ω | 50 W | | |
| SET B 0 . 9 | -0.98 V Enter | | |
| B +/- | | | |
| ENTER | ----- | | |
| AC/DC | AC | | |
| 1X/10X | 10X | | |
| COM A | COM A | | |
| HOLD OFF ON | HOLD OFF | | |
| HOLD OFF SET | hoff ti | | |

| Keyboard Test (page 2-3) | | | |
|--------------------------------|---------------------------|------|------|
| Key(s) | Display | Pass | Fail |
| PRESET | ----- | | |
| Other | | | |
| PRESET | Preset | | |
| | ----- | | |
| MEAS TIME SET | 200 ⁻³ s | | |
| SELECT \blacktriangle | 500 ⁻³ s | | |
| ENTER | ----- | | |
| HOLD | DISPL HOLD | | |
| HOLD | | | |
| SINGLE | SINGLE | | |
| FUNCTION \blacktriangleleft | VOLT A MAX/MIN | | |
| FUNCTION \blacktriangleleft | RISE/FALL A | | |
| FUNCTION \blacktriangleright | VOLT A MAX/MIN | | |
| FUNCTION \blacktriangleright | FREQ A | | |
| AUX MENU | Addr | | |
| RESTART | ----- | | |
| PRESET | ----- | | |
| ENTER | | | |
| STARTARM | Ar.Sta Off | | |
| RESTART | ----- | | |
| STOPARM | Ar.StO OFF | | |
| RESTART | ----- | | |
| PRESET | Preset | | |
| | ----- | | |
| CHECK | 1000000000 ⁶ | | |
| MATH | Arith OFF | | |
| SELECT \blacktriangledown | Arith ON | | |
| ENTER | 1000000000 ⁶ | | |
| K= | 10 | | |
| 2 | 2 | | |
| ENTER | 2000000000 ⁶ + | | |
| L= | 00 | | |
| Xn-1 | n-1 | | |
| ENTER | 3000000000 ⁶ + | | |
| L= | n-1 | | |

| Keyboard Test (page 2-3) | | | | |
|-----------------------------|--|------|------|--|
| Key(s) | Display | Pass | Fail | |
| 0 ENTER | 2000000000 ^{6*} | | | |
| L= X0 ENTER | 4000000000 ^{6*} | | | |
| L= | 2000000000 ^{6*} | | | |
| 4 EE 6 ENTER | 2400000000 ^{6*} | | | |
| M= . 5 | 0.5 | | | |
| ENTER | 4800000000 ^{6*} | | | |
| STAT | Stat. OFF | | | |
| ENTER | 4800000000 ^{6*} | | | |
| FUNCTION ◀ (6 times) | TOT A-B MAN | | | |
| TOT St/St | Gate LED lit | | | |
| MENU | Displays all available functions, processes and input controls. Selected items are blinking. | | | |
| PRESET ENTER | -----** | | | |

*) The LSD digit may vary.

**) MENU is not disabled by setting DEAFULT, press menu again.

| Sensitivity and Frequency Range (page 2-4) | | | | |
|---|---------------------------------|---------------|------|------|
| Frequency | Level | Measure value | Pass | Fail |
| Input A | | | | |
| 1 MHz | 20 mV _{RMS} -21 dBm | | | |
| 50 MHz | 20 mV _{RMS} -21 dBm | | | |
| 100 MHz | 20 mV _{RMS} -21 dBm | | | |
| 200 MHz | 30 mV _{RMS} -17 dBm | | | |
| 250 MHz | 40 mV _{RMS} -15 dBm | | | |
| 300 MHz | 60 mV _{RMS} -11 dBm | | | |
| Input B | | | | |
| 1 MHz | 20 mV _{RMS} -21 dBm | | | |
| 50 MHz | 20 mV _{RMS} -21 dBm | | | |
| 100 MHz | 20 mV _{RMS} -21 dBm | | | |

| Check VMAX/VMIN (page 2-4) | | | | |
|-------------------------------|--|----------------|------|------|
| Input signal | Level V _{MAX} V _{MIN} | Measured value | Pass | Fail |
| Input A | | | | |
| None | 0 ±4 mV | | | |
| | 0 ±4 mV | | | |
| 4.00 V _{DC} | 4.000 ±0.044 V | | | |
| | 4.000 ±0.044 V | | | |
| 40 V _{DC} | 40 ±0.84 V | | | |
| | 40 ±0.84 V | | | |
| -4.00 V _{DC} | -4.000 ±0.044 V | | | |
| | -4.000 ±0.044 V | | | |
| -40 V _{DC} | -40 ±0.84 V | | | |
| | -40 ±0.84 V | | | |
| 4.00 V _{PP} | 4.00 ±0.244 V | | | |
| | 18 V _{PP} | 18 ±1.84 V | | |
| Input B | | | | |
| None | 0 ±4 mV | | | |
| | 0 ±4 mV | | | |
| 4.00 V _{DC} | 4.000 ±0.044 V | | | |
| | 4.000 ±0.044 V | | | |
| 40 V _{DC} | 40 ±0.84 V | | | |
| | 40 ±0.84 V | | | |
| -4.00 V _{DC} | -4.000 ±0.044 V | | | |
| | -4.000 ±0.044 V | | | |
| -40 V _{DC} | -40 ±0.84 V | | | |
| | -40 ±0.84 V | | | |
| 4.00 V _{PP} | 4.00 ±0.244 V | | | |
| | 18 V _{PP} | 18 ±1.84 V | | |

| Trigger Indicator (page 2-4) | | | |
|---------------------------------|-------------------|------|------|
| Manually set trigger level | Trigger indicator | Pass | Fail |
| Input A | | | |
| + 1 V | off | | |
| - 1 V | on | | |
| 0.0 V | blinking | | |
| Input B | | | |
| + 1 V | off | | |
| - 1 V | on | | |
| 0.0 V | blinking | | |

| Trigger Level (page 2-4) | | | | |
|---|-------------------|------|------|--|
| Trigger setting | Trigger indicator | Pass | Fail | |
| Input A | | | | |
| SET A = 0 V | blinking | | | |
| DC coupling | on | | | |
| SET A = 0.7 V | blinking | | | |
| 50 Ω Impedance | off | | | |
| SET A = 0.2 V | blinking | | | |
| AC coupling & 1 M Ω Impedance | blinking | | | |
| X10 Attenuation | off | | | |
| SET A = 0.0 V | blinking | | | |
| X1 Attenuation | blinking | | | |
| Input B | | | | |
| SET B = 0 V | blinking | | | |
| DC coupling | on | | | |
| SET B = 0.7 V | blinking | | | |
| 50 Ω Impedance | off | | | |
| SET B = 0.2 V | blinking | | | |
| AC coupling & 1 M Ω Impedance | blinking | | | |
| X10 Attenuation | off | | | |
| SET B = 0.0 V | blinking | | | |
| X1 Attenuation | blinking | | | |



| Reference Oscillators (page 2-5) | | | | |
|-------------------------------------|---------------------------------|----------------|------|------|
| Oscillator | Frequency readout | Measured value | Pass | Fail |
| Standard, 01 | 10.00000000 MHz ± 150 Hz | | | |
| PM 9678B, 02 | 10.00000000 MHz ± 15 Hz | | | |
| PM 9690, 04 | 10.00000000 MHz ± 2 Hz | | | |
| PM 9691, 05 | 10.00000000 MHz ± 1 Hz | | | |

| Resolution Test (page 2-5) | | | |
|-------------------------------|------|------|--|
| Readout | Pass | Fail | |
| < 0.05 μ s | | | |

| Rear Input/Output (page 2-5) | | | | |
|---------------------------------|-------------------------------------|----------------|------|------|
| Function | Readout | Measured value | Pass | Fail |
| EXT REF OUT | >1.4 V _{PP} 500 Vrms | | | |
| GATE OPEN Output | — | | | |
| REFERENCE IN | 10.00000000 μ Hz ± 5 LSD | | | |
| EXT ARM Input | — | | | |

| Trig Level Outputs (page 2-6) | | | | |
|----------------------------------|--------------------|----------------|------|------|
| SET A(B) | Readout | Measured value | Pass | Fail |
| Input A | | | | |
| + 5.00 V | + 5 V ± 0.28 V | | | |
| – 5.00 V | – 5 V ± 0.28 V | | | |
| 0.00 V | 0 V ± 30 mV | | | |
| Input B | | | | |
| + 5.00 V | + 5 V ± 0.28 V | | | |
| – 5.00 V | – 5 V ± 0.28 V | | | |
| 0.00 V | 0 V ± 30 mV | | | |

| Probe Comp View (page 2-6) | | | | |
|-------------------------------|----------------------------|----------------|------|------|
| Attenuator | Oscilloscope readout | Measured value | Pass | Fail |
| Input A | | | | |
| X1 | 2 kHz, 4 V _{PP} | | | |
| X10 | 2 kHz, 0.4 V _{PP} | | | |
| Input B | | | | |
| X1 | 2 kHz, 4 V _{PP} | | | |
| X10 | 2 kHz, 0.4 V _{PP} | | | |

| Measuring Functions (page 2-6) | | | | |
|--|-------------------------------------|----------------|------|------|
| Selected Function | Display | Measured value | Pass | Fail |
| FREQ A | 10 MHz ²⁾ | | | |
| FREQ C | | | | |
| PER A | 100 ⁻⁹ s ²⁾ | | | |
| RATIO A/B | 10000000 | | | |
| NEG SLOPE B | | | | |
| RATIO C/B | 00000000 | | | |
| PWIDTH A | 50000 ⁻⁹ s ¹⁾ | | | |
| TIME A-B | 50000 ⁻⁹ s ¹⁾ | | | |
| PHASE A-B | 180 or -180 ¹⁾ | | | |
| TOT A-B | 0 | | | |
| MAN | | | | |
| Not COM A | 0 | | | |
| TOT ST/STOP | counting | | | |
| TOT ST/STOP | stop counting | | | |
| COM A | 0 | | | |
| TOT A | 1 | | | |
|  B | | | | |
| TOT A | 1 | | | |
|  B | | | | |
| POS SLOPE B | 0 | | | |
| DUTY F A | 0500000 ¹⁾ | | | |
| AUTO | 0500000 ¹⁾ | | | |
| RISE/FALL | 30000 ⁻⁹ s ²⁾ | | | |
| VOLT A | +1000 | | | |
| MAX/MIN | -1000 V | | | |

1) Value depends on the symmetry of the signal.

2) Exact value depends on input signal.

| HOLD OFF (page 2-7) | | | | |
|------------------------|---------------------|----------------|------|------|
| Hold Off | Readout | Measured value | Pass | Fail |
| Off | 10 ⁻⁹ s | | | |
| 1-6 s | 1 ⁻⁶ s | | | |
| 500-9 s | 500 ⁻⁹ s | | | |

| Sensitivity of PM 9621 (page 2-7) | | | | |
|--------------------------------------|---------------------------------|----------------|------|------|
| Frequency | Amplitude | Measured value | Pass | Fail |
| 70-900 MHz | 10 mV _{RMS} -27 dBm | | | |
| -1100 MHz | 15 mV _{RMS} -23 dBm | | | |
| -1300 MHz | 40 mV _{RMS} -15 dBm | | | |

| Sensitivity of PM 9624 (page 2-7) | | | | |
|--------------------------------------|---------------------------------|----------------|------|------|
| Frequency | Amplitude | Measured value | Pass | Fail |
| 100-300 MHz | 20 mV _{RMS} -21 dBm | | | |
| -2500 MHz | 10 mV _{RMS} -27 dBm | | | |
| -2700 MHz | 20 mV _{RMS} -21 dBm | | | |

| Sensitivity of PM 9625B (page 2-7) | | | | |
|---------------------------------------|-----------------------------------|----------------|------|------|
| Frequency | Amplitude | Measured value | Pass | Fail |
| 150-300 MHz | 20 mV _{RMS} -21 dBm | | | |
| -2200 MHz | 10 mV _{RMS} -27 dBm | | | |
| -3500 MHz | 15 mV _{RMS} -23.5 dBm | | | |
| -4200 MHz | 25 mV _{RMS} -19 dBm | | | |

| Sensitivity of PM 9625 (page 2-7) | | | | |
|--------------------------------------|-----------------------------------|----------------|------|------|
| Frequency | Amplitude | Measured value | Pass | Fail |
| 150-300 MHz | 20 mV _{RMS} -21 dBm | | | |
| -2500 MHz | 10 mV _{RMS} -27 dBm | | | |
| -3500 MHz | 15 mV _{RMS} -23.5 dBm | | | |
| -4200 MHz | 25 mV _{RMS} -19 dBm | | | |
| -4500 MHz | 50 mV _{RMS} -13 dBm | | | |

| Total Performance check | | | Pass | Fail |
|-------------------------|--|--|------|------|
| Date: | | | | |
| Test performed by: | | | | |

Chapter 3

Disassembly

The terms in the following figure are used in all descriptions in this manual.

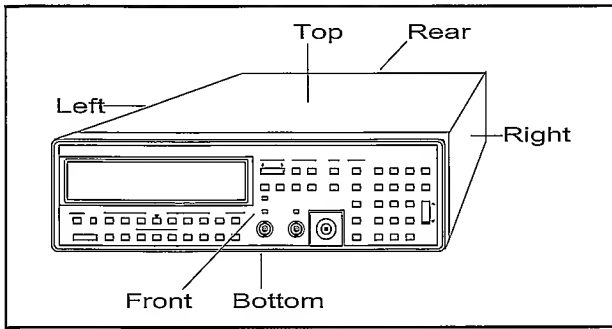


Figure 3-1 Terms used in this manual.

The PM 6681 is available with a number of options and accessories. The labels on the rear panel of the counter identify the options and accessories included. If there are no labels, the counter contains an uncompensated crystal oscillator and no options. The following labels exist:

PM 9611/81 Rear Panel Inputs

PM 9621 1.3 GHz HF input

PM 9624 2.7 GHz HF input

PM 9625 4.5 GHz HF input

PM 9678B TCXO

PM 9690 Oven Oscillator

PM 9691 Oven Oscillator

The location of these optional parts is illustrated in Fig. 3-2.

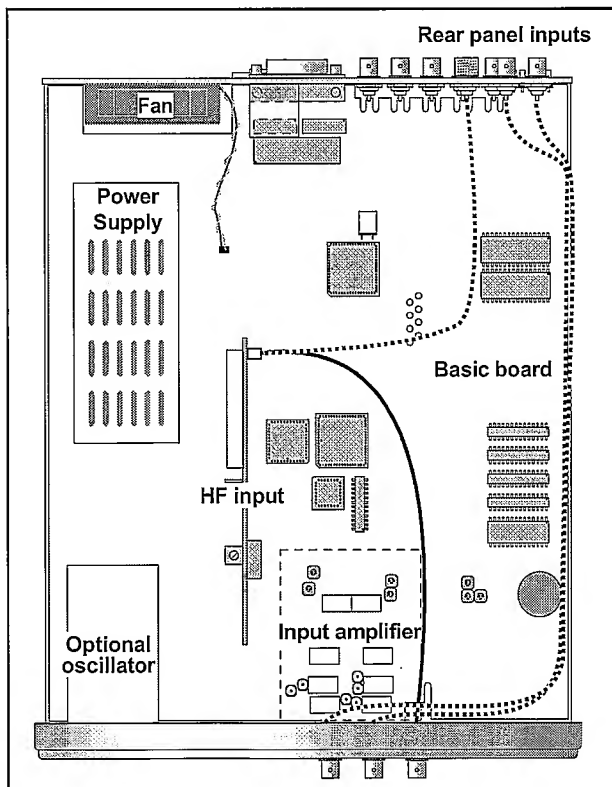


Figure 3-2 Location of the boards in the counter.

Removing the Cover

WARNING: Do not perform any internal service or adjustment of this instrument unless you are qualified to do so.

WARNING: When you remove the cover you will expose live parts and accessible terminals which can cause death.

WARNING: Although the power switch is in the off position, line voltage is present on the printed circuit board. Use extreme caution.

WARNING: Capacitors inside the instrument can hold their charge even if the instrument has been separated from all voltage sources.

- Make sure the power cord is disconnected from the counter.
- Turn the counter upside down.
- Loosen the screw (A) at the bottom and the two screws (B) in the rear feet.
- Grip the front panel and gently push at the rear.
- Pull the counter out of the cover.

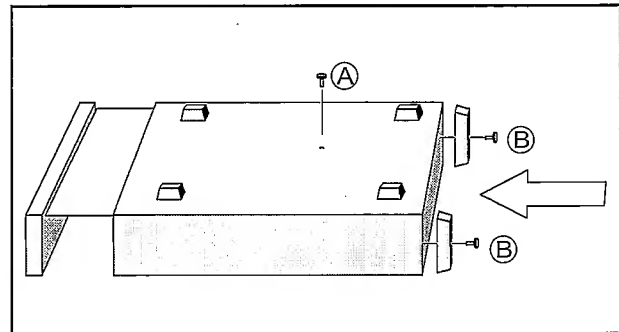


Figure 3-3 Remove the screws and push out the counter from the cover.

Reinstalling the Cover

- Push the counter gently back in the cover.
- NOTE:** Be sure that the screen shielding on the front make contact to the cover.
- Turn it upside down
 - Install the two screws (A) at the bottom.
 - Install the two rear feet with the screws (B) to the rear panel.

Fan

- Disconnect the power cable.
- Remove the cover from the counter.
- Remove the two screws (A) and nuts (B) from the fan.
- Disconnect the fan cable from J18.
- When reinstalling the fan, be sure that the air-flow arrow on the fan points to the rear of the counter and that the black wire is oriented toward the power module.

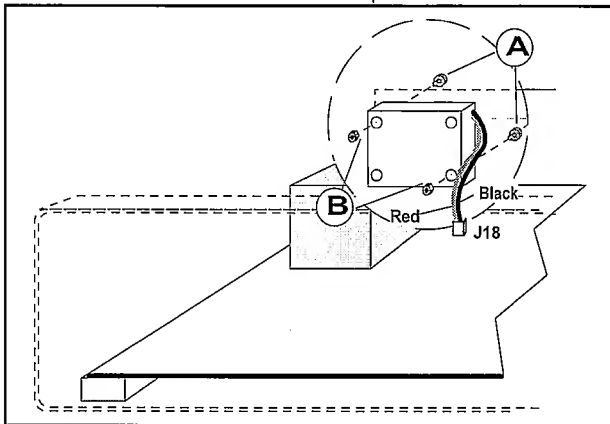


Figure 3-4 The fan is fastened with four screws and nuts.

PM 9621, PM 9624 or PM 9625 HF Input

- Disconnect the power cable.
- Remove the cover from the counter.
- Disconnect the cable from the mini-coax connector (A) on the HF input.
- Press the clips (B) apart and lift the HF input pca straight up and out.
- When installing the HF input, make sure that the connector pins fit exactly in the holes in the connector housing (C).

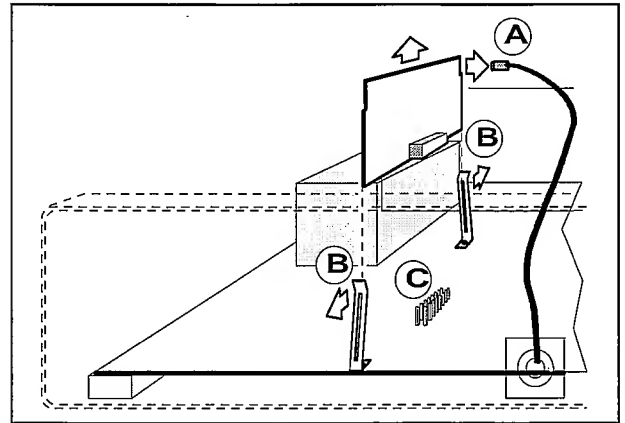


Figure 3-5 Removing the HF input.

PM 9678B TCXO

- Disconnect the power cable.
- Remove the cover of the counter.
- Remove the screw (A) holding the TCXO to the main pca from beneath.
- Lift the TCXO straight up.
- Make sure that the jumpers J12 and J15 are set in the correct position.
- When installing the TCXO, make sure that the connector pins fit exactly in the holes in the connector housing.

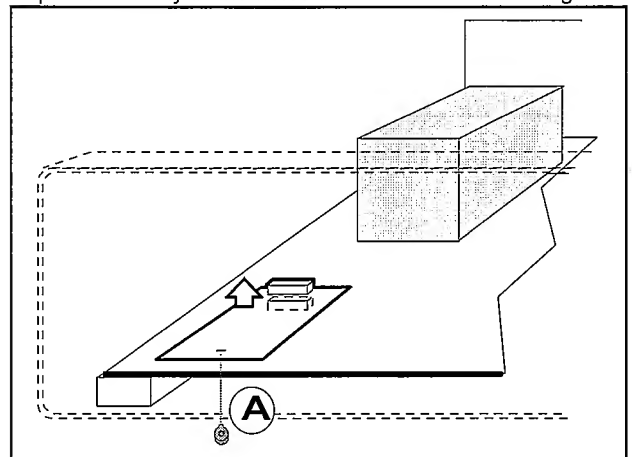


Figure 3-6 Lift the TCXO straight up after removing the fastening screw.

PM 9690 or PM 9691 Oven Oscillator

- Disconnect the power cable.
- Remove the cover of the counter.
- Remove the screw (A) holding the oscillator to the main pca from beneath.
- Press the clip (B) gently to the front of the counter and lift the oscillator straight up.
- Make sure that the jumpers J12 and J15 are set in the correct position.
- When fitting the oscillator, make sure that the connector pins fit exactly in the holes in the connector housing.

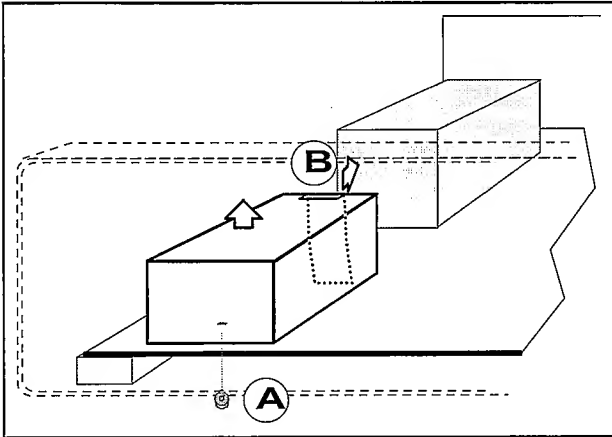


Figure 3-7 A clip and a screw hold the oven oscillators in place.

Reinstalling the Battery

The instrument will lose its stored programs and front panel settings when the battery is replaced if not connected to the line power.

WARNING: Disposal of lithium batteries requires special attention. Do not expose the batteries to heat or put them under extensive pressure. These measures may cause the batteries to explode.

Return used batteries to your supplier or to your local Fluke organization.

Exchange Procedure

- Remove the cover of the counter.
- connect the counter to the line power but keep it switched off.
- Lift the metal clip and press the battery towards the front of the counter using a screwdriver.

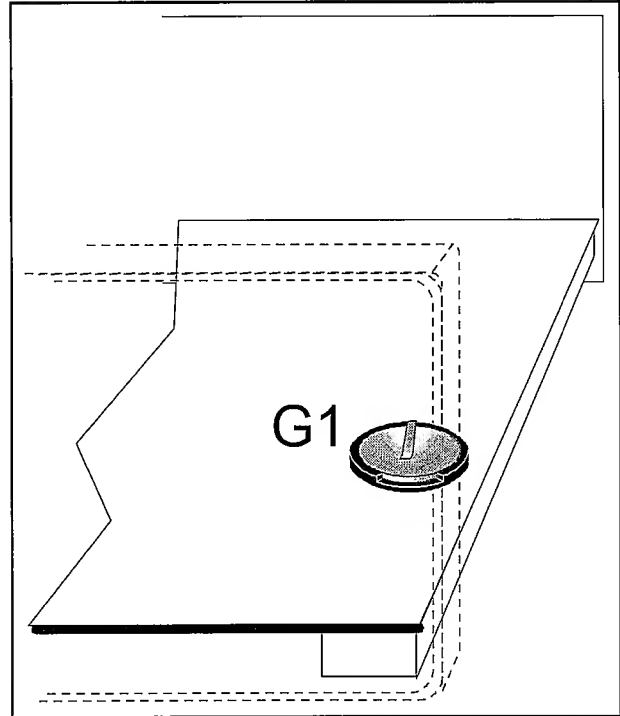


Figure 3-8 Location of battery G1.

- Clean the battery connectors with a cotton swab and alcohol.

NOTE: Do not touch the new battery with your hands to avoid self discharging.

- Insert a new battery between the metal clip and the plastic holder. You will find the ordering number in the Replacements Parts Chapter.
- Disconnect the power cable.
- Reinstall the cover to the counter.

Don't throw batteries in your wastebasket. Return used batteries to your supplier.

Chapter 4

Circuit Descriptions

Block Diagram Description

General

The PM 6681 Timer/Counter consists of three main units:

- Front unit
- Main board unit
- Rear panel unit

Several options can be added, these are:

- Prescalers (1.3 GHz PM 9621, 2.7 GHz PM 9624, 4.2 GHz PM 9625B, and 4.5 GHz PM 9625)
- Oscillators (TCXO PM 9678B and oven oscillators PM 9690 and PM 9691)
- Rack mount adapter (PM 9622)
- Rear panel inputs (PM 9611/81)

The chassis of the counter consists of a front piece molded in aluminum, an aluminum rear panel, and three aluminum profiles that hold the front and rear panels together. This unit can be slid into the aluminum cover of the instrument.

The front unit contains all functions needed for the user communication. A flat cable connects the front unit to the main board unit, and the molded front-piece screws onto the two aluminum profiles.

Most functions, such as the following, are placed on the main board:

- Input amplifiers with trigger level circuits
- Power supply
- Measurement logic
- Microcomputer circuitry
- GPIB-bus
- Analog output
- External reference input
- External arming input

Some outputs, such as the TRIGGER LEVEL and PROBE COMPENSATION VIEW outputs are directly mounted on the main board.

The rear panel unit is an aluminum panel with a number of mounted connectors. Most of the connectors are soldered directly to the main board. The rear panel screws onto the two aluminum profiles.

NOTE: Simplified extractions from the Schematic diagrams are used in this chapter. For complete information, see Chapter 8, Schematic Diagrams.

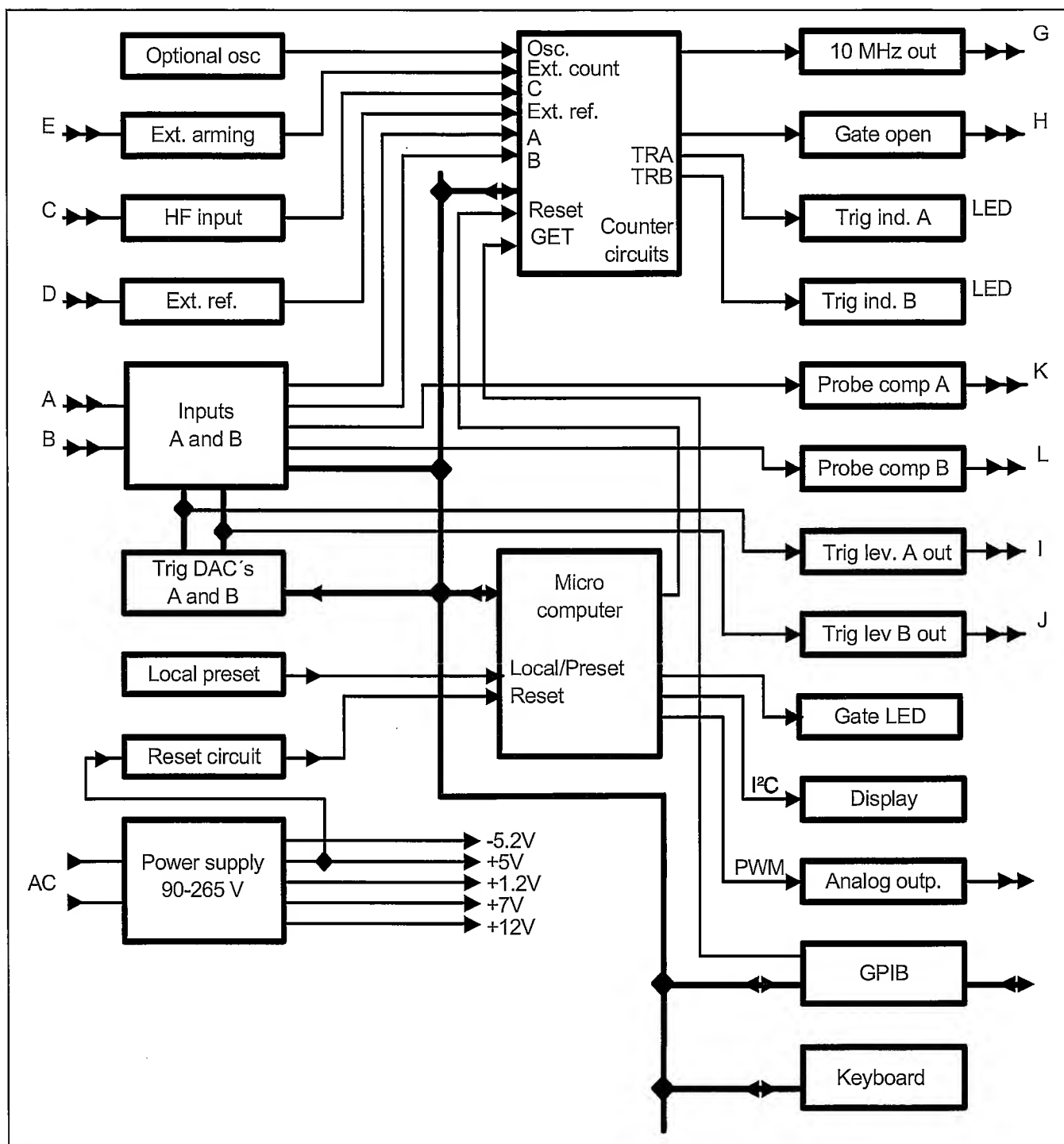


Figure 4-1 Block diagram PM 6681.

Hardware Functional Description

Front Unit

LCD Drivers

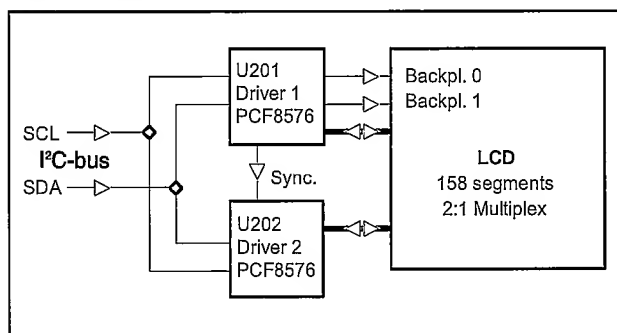


Figure 4-2 Front panel LCD drivers.

The front unit is made of a molded aluminum front. The keypad is made of silicon rubber with screened carbon pads on a PC board that covers the total front. An LCD and four LED's are used as indicators. To show both the measurement result and the state indicators of the instrument setting a LCD is used. The LED's shows standby, gating, and triggering channel A and B.

It has 160 segments that are multiplexed with a ratio of 2:1. Two cascade coupled LCD drivers (U201 and U202) are used. A serial I²C bus connects the drivers to the μ -controller on the main board. R201 sets the clock frequency of the drivers to approximately 140 kHz. The VLCD pin is connected to GND on the main board.

A back-light is provided with the LCD. This is an LED array integrated to one component. It uses approximately 0.35 A and dissipates approximately 1.5 W.

Keyboard

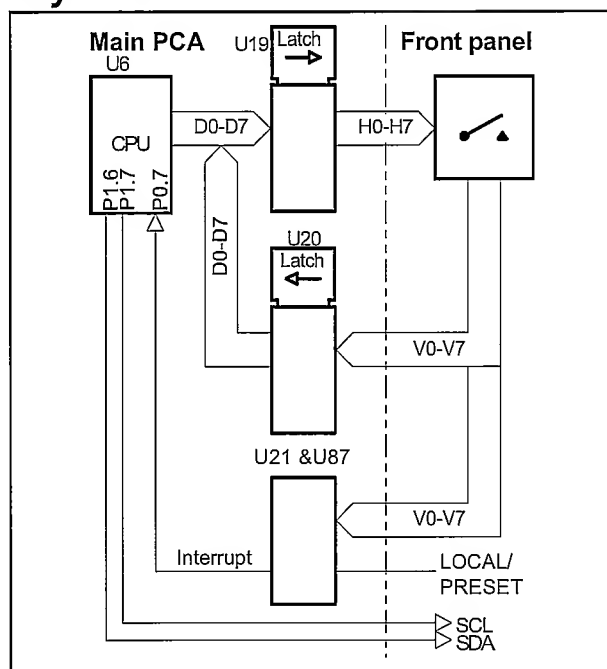


Figure 4-22 Keyboard scanning.

The push buttons are connected in a matrix and the scanning signals H0 to H7 are coming from the main board. If a button is pressed and H0 to H7 is high, one of the output signals V0 to V7 will be high. V0 to V7 are also connected to an interrupt input, P0.7 on the μ -controller U6 via the AND gates U21 and U87. The LOCAL-PRESET button is not part of the scanning, but connected directly to the AND gates U21 and U87.

Three screws fix the front unit to the main board unit. A 40-pin flat cable electrical connects the front unit to the main board.

Main Board

Input Amplifier A

Input amplifiers A and B are two matched 300 MHz amplifier circuits: Channel A and channel B.

Channels A and B are identical except the 100-kHz filter in channel A, the switching circuitry for the separate/common modes, the B-channel delay line, and event delay output. The following description refers to channel A but is also valid for channel B, (see Figure 4-4).

Four main stages makes the input amplifier: Input stage, impedance converter stage, comparator stage and buffer stage.

• Input Stage

The input stage contains:

- 50 Ω /1 M Ω impedance selector
- 1X/10X attenuator
- AC/DC coupling
- Voltage limiter

50 Ω /1 M Ω impedance selector

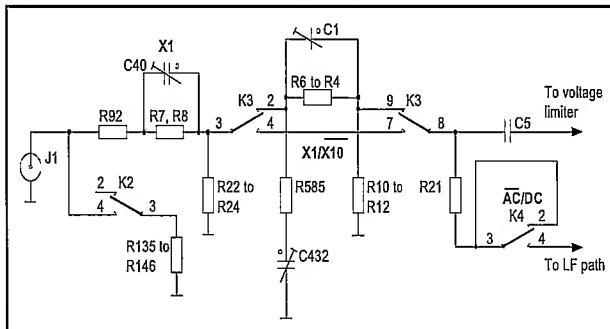


Figure 4-3 Impedance selector, 1X/10X attenuator and AC/DC coupling.

Relay K2A select 50 Ω or 1 M Ω impedance mode. 50 Ω is selected via resistors R135 to R146 if the relay switch is

closed. 1 M Ω is selected if the switch is open, (see Figure 4-3). Depending on selected attenuation, the 1 M Ω input impedance is determined by different combination of resistors. Resistor network R7, R8, R22 to R24, and R92 determines the 1X attenuation. Together with 1X resistors R4 to R6 and R10 to R12 sets the impedance in 10X attenuation. The input capacitance in parallel with 1 M Ω is 15 pF. Resistor R92 immediately after the selector serves both as current limiter with the voltage limiter (see below) and as impedance matching resistor. This resistor also improves the V Standing Wave Ratio of the amplifier.

1X/10X attenuator

The 1X attenuator consists of the resistive low frequency divider, which reduces the input signal by a factor of 2.3. R7, R8, R22 to R24, and R92 forms the attenuator, (see Figure 4-3). The variable capacitor C40 and the parasitic capacitance forms the capacitive high frequency divider in parallel with R22 to R24.

Variable capacitor C40 adjusts the capacitive attenuator to the same attenuation as the resistive.

Resistors R4 to R6 and R10 to R12 forms the 10X attenuator. The variable capacitor C1 and the resistors R10 to R12 forms the capacitive divider. The parasitic capacitance is in parallel with resistor R10 to R12.

C432 set the 10X input capacitance equal to the 1X input capacitance.

AC/DC coupling

Relay K4A select AC/DC - coupling. In AC coupling relay K4A is open and the signal is fed through the AC capacitor C5, (see Figure 4-3). In DC coupling the relay K4A is closed and the AC capacitor C5 is short-circuited. To protect the relay contact the two resistors R20 and R21 serve as current limiters.

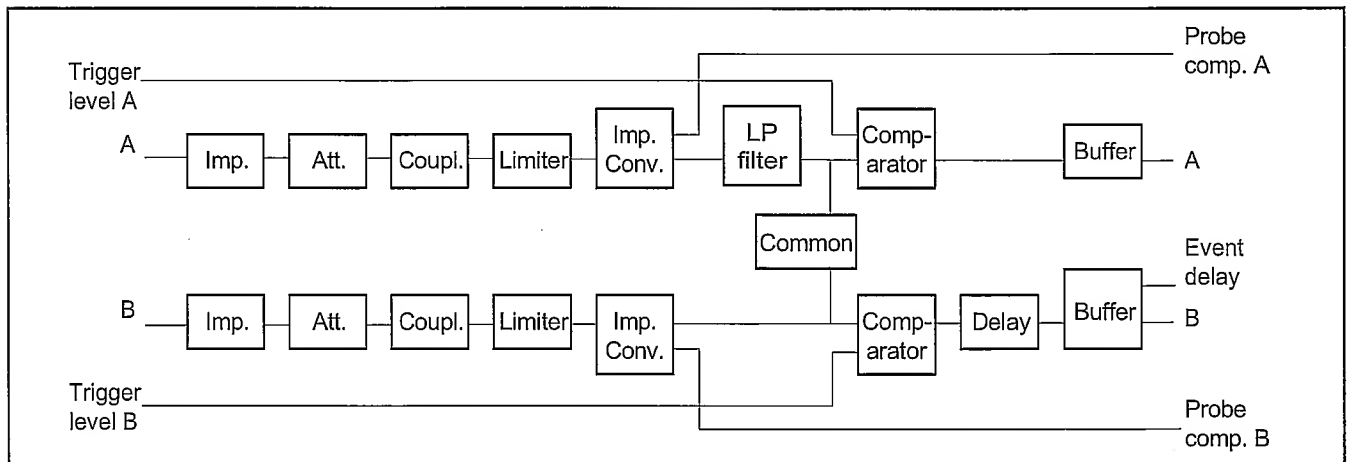


Figure 4-4 Input amplifier block diagram.

Voltage limiter

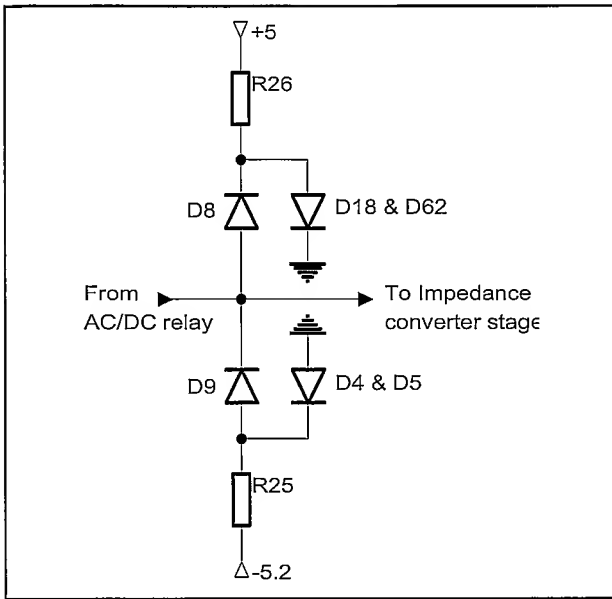


Figure 4-5 Voltage limiter.

A voltage limiter that protects the impedance converter against over voltage is placed between the AC/DC selector and the impedance converter, (see Figure 4-5). It consists of resistor R26, the diodes D18, D62, and D8 to clamp positive voltage. Resistor R25 plus the diodes D4, D5, and

D9 to clamp negative voltage. The clamp voltage is approximately 2.7 V at low frequency signals. At high frequency the clamp voltage rises to approximately 3.0 V.

• Impedance Converter Stage

The analog signal from the input stage is fed to an amplifier stage where split-band technique is used to get a good frequency response over a wide range, (see Figure 4-6). This means that the high frequency path of the signal is fed via a high impedance AC-coupled FET transistor stage. In parallel via a DC coupled feedback operational amplifier stage, the low frequency path is fed. The low frequency path handles frequencies up to approximately 5 kHz.

Through the FET, V1 gate the high frequency signal is fed. The high impedance at the gate is converted to a low impedance at the source. Common for both high frequency and low frequency path the source is connects to the HF-transistor V25.

To make the FET work well in its active region within the whole dynamic range, the FET-drain is supplied with +12 V via resistor R94.

Two resistors, R16 and R17 divides the low frequency signal before it is coupled to the input pin 2 of the operational amplifier U1. Resistors R14 and R15 at U1 pin 6, center the output swing, and capacitor C3 stabilizes the operational amplifier stage.

The low frequency path goes via the operational amplifier, the base and collector of the transistor V25. This point (collector of V25) is the common point for the high and low frequency paths of the input frequency.

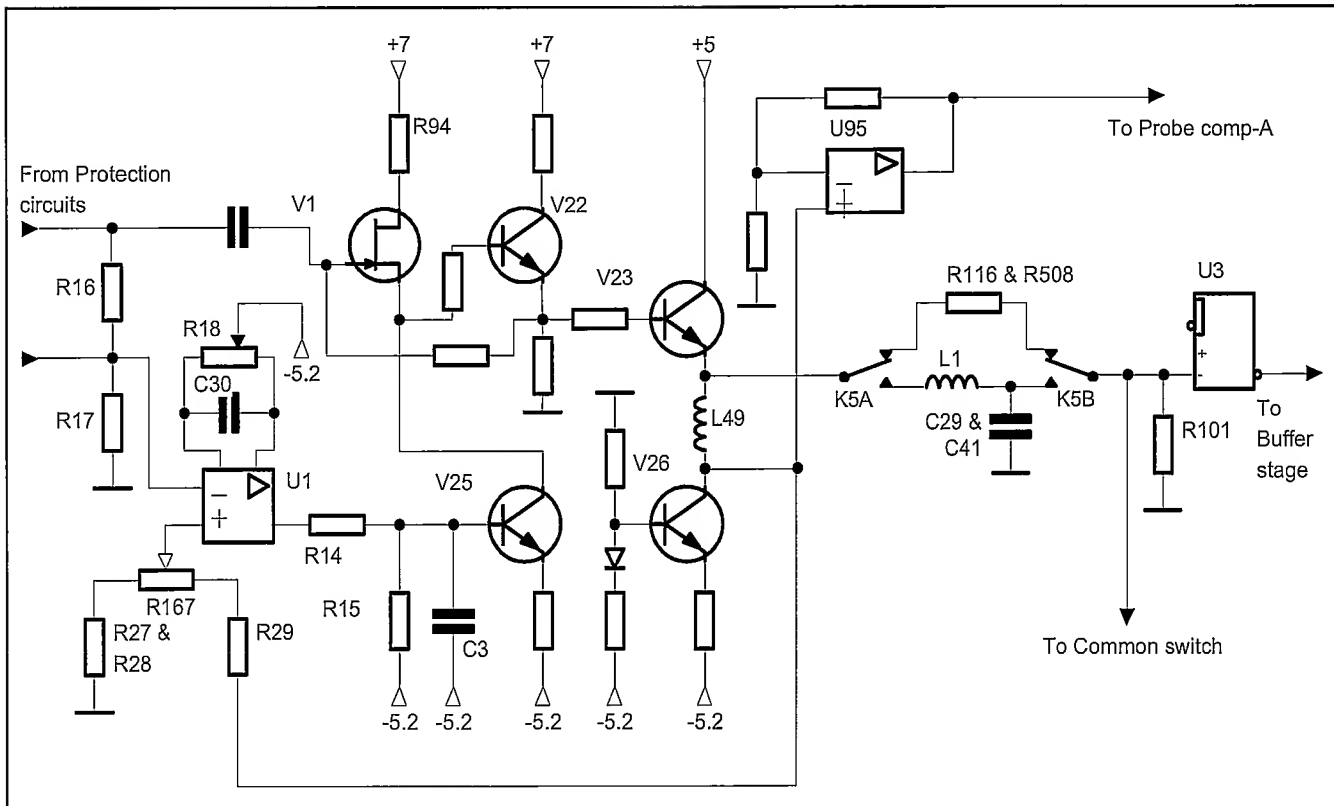


Figure 4-6 Impedance converter.

The output of the amplifier stage is also connected to the rear panel via the amplifier U95. By using this output called "PROBE COMPENSATION A" it is possible to compensate a probe connected to the counter. This voltage is also connected to an analog input in the μ -controller. This makes it possible for the μ -controller to get a quick knowledge about the input voltage.

Input Amplifier B

Input channel B is the same as input channel A with the following exceptions:

- The Common B via A switches, that connect the B-channel comparator to the input signal on channel A.
- The B-channel delay line.
- The B-channel has no lowpass filter.
- The B-channel has a special event-delay signal output to OQ0504, U56.

• Delay Line

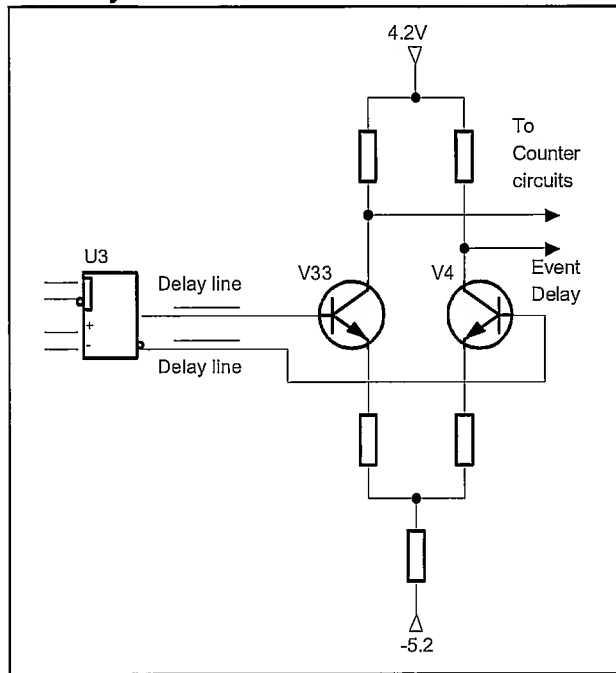


Figure 4-9 Delay lines.

A line of approximately 65 cm is placed between the "B-channel comparator output" pins 15 and 16 and the buffer stage V33 and V4, (see Figure 4-9). This delay line is a

part of the circuit board. It should compensate for delays in OQ0502, U58.

• Event Delay

Also for use in the arming function, the inverse output from the buffer stage V4 of channel B is used, (see Figure 4-10). This signal called EVENT-DELAY, is connected to the OQ0504 circuit U56 via the transistor V12 and the IC, U47 which works as a multiplexer.

The EVENT-DELAY signal is also used by the HOLD-OFF logic when the input pulses should be counted, (see Counter circuits on page 11).

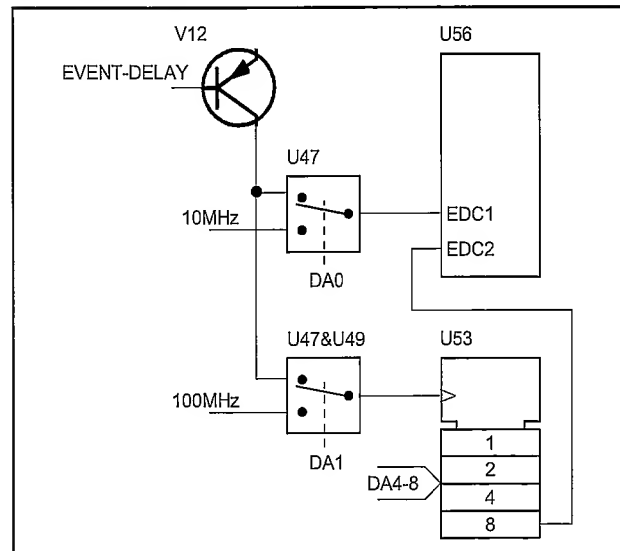


Figure 4-10 Event delay.

Calibration Circuits

U93 and a delay line on the PCA generates a xx ns long pulse, and feed it to channel B input on the counter IC, U56. This pulse is initiated by the μ -controller pulse CAL-TEST-PULSE.

Trigger Level Circuits

The trigger level circuits generate the trigger levels to the A and B inputs. The trigger level range is -5.1 V to $+5.1\text{ V}$ with a resolution of 1.25 mV . As the input amplifier attenuation is approximately about 2.4 times, the trigger level circuits generate a DC level that has the same attenuation. This means that the output of this circuit has a range of -2.2 V to $+2.2\text{ V}$ with a resolution of 0.5 mV . To get the high resolution, two 12-bit DACs are used. The supply voltages to the trigger level circuits are filtered to prevent noise from the digital circuitry to influence the trigger level, (see Figure 4-11).

The trigger level circuits consists of:

- Reference voltage circuit (2.5 V), (U86).
- Reference voltage inverter circuit (-2.5 V), (U59).
- A multiplexer to select positive or negative reference voltage and Full scale B or Full scale common B trimmers, (U60).
- Buffer circuits, (U61 and U62).
- Two Digital to Analog converters, (U63 and U64).
- Two current-to-voltage converters (U65 and U66). These circuits convert the current at the IOOUT pins of the DACs to a voltage. This signal has a range of approximately -2.1 V to 2.1 V .
- Two output buffers and RC filters for the trigger level outputs on the rear panel. (U67).

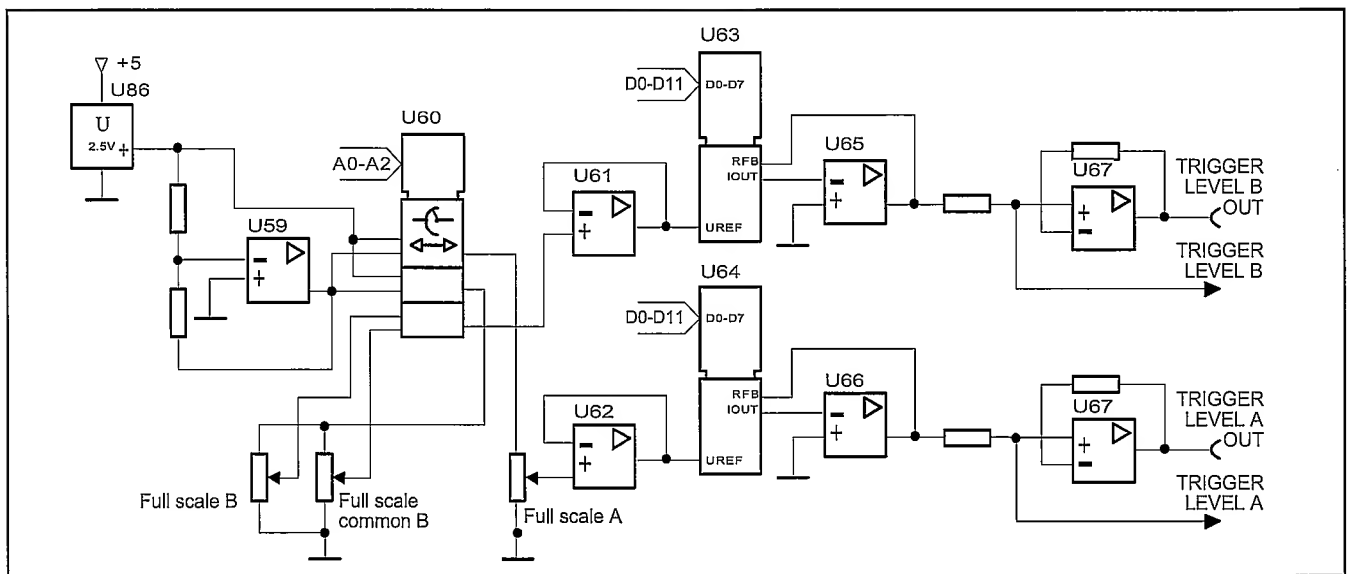


Figure 4-11 Trigger level circuits.

Power Supply

• Primary Circuits

The power supply generates five regulated DC supply voltages to the counter. It also generates some other supply voltages for special purposes. The power supply block also contains the ON/STANDBY logic, (see Figure 4-12).

The main building-block of the power supply is the primary switch mode power circuits. A rectifier make a DC-voltage of the line power AC-voltage (90 V to 265 V), before it is fed to the switch circuits.

After a line-power filter in the power inlet, a fuse and an NTC-resistor protect the power supply. The fuse (F1) should only blow if a catastrophic error occurs on the primary side of the power supply. A short-circuit on the secondary side should not affect the primary side. To minimize the "current rush" to the capacitors at the connection of the power cord, an NTC-resistor (R337) is used. The resistance is 16Ω when the resistor is cold, but decrease to a few ohms when warmed up by the current. The AC voltage is rectified in the bridge rectifier D40 and filtered in C330. C181, C183, and C184 should suppress noise from D40. L20, C173, and C174 forms filters.

L39 and L40 prevent HF-noise from the switch circuitry to reach the line-power inlet.

R460 to R463, R467, and R468 gives the start up voltage to the control circuitry U91. U91 outputs a frequency of 120 kHz on OUT (pin 10) to the switch transistor V55. When the switch transistor has started U91 will be supplied from the transformer T1 pin 3 via the diodes D50A and D50B.

Every switch pulse causes a voltage drop over the resistors R471 to R473 and R558. This voltage feeds the SENSE input (pin 5) of the control circuit U91. When the voltage has reached the internal reference level in U91, the switch transistor V55 is turned off.

V60 is a blanking transistor that will compensate for high transients generated by the transformer T1.

The internal sawtooth generator RC (pin 7) in U91 is connected to the SENSE input via V57, to compensate for low load.

The regulated +5 V is sensed by U92 and adjusted by R446. The output of U92 is connected to the VF input (pin 3) of U91 via the opto coupler U90.

The VREF pin (pin 14) outputs a reference voltage of 5 V DC.

• Secondary Circuits

A voltage over the capacitor C373 is generated by the diodes D56A and D56B. This voltage is used to generate a power-failure interrupt, (NMI) to the μ-controller, when the line-power disappears, (see Figure 4-13).

From the module there are three DC voltages outputs. One of those is regulated (+5 V) and the others are unregulated. These voltages will vary with input line voltage, the current at +5 V, and at the unregulated voltages. The output, marked +15, will be 14.8 V to 21 V and the output, marked -9, will be -12.5 V to -7.5 V. The outputs are filtered, HF-filtered by C176, C177, and C178 and LF-filtered by L19, L21, L22, C179, C329, and C333.

These three DC voltages are used to make the following five supply voltages in the counter:

+5 V

From the switch transformer T1 via D43 and regulated by V49 and U72..

-5.2 V

-9 V is regulated by V17, U73, and U74.

+12 VREG

+15 V is regulated to +12 V by U69.

+12 VREG is used for the optional oven oscillator and the STAND-BY indicator.

+12 V

+12REG V is switched on and off by +5 V via V18 and V48.

+7 V

U70 and U71 regulates +12 V to be +7 V.

The voltages for special purposes are:

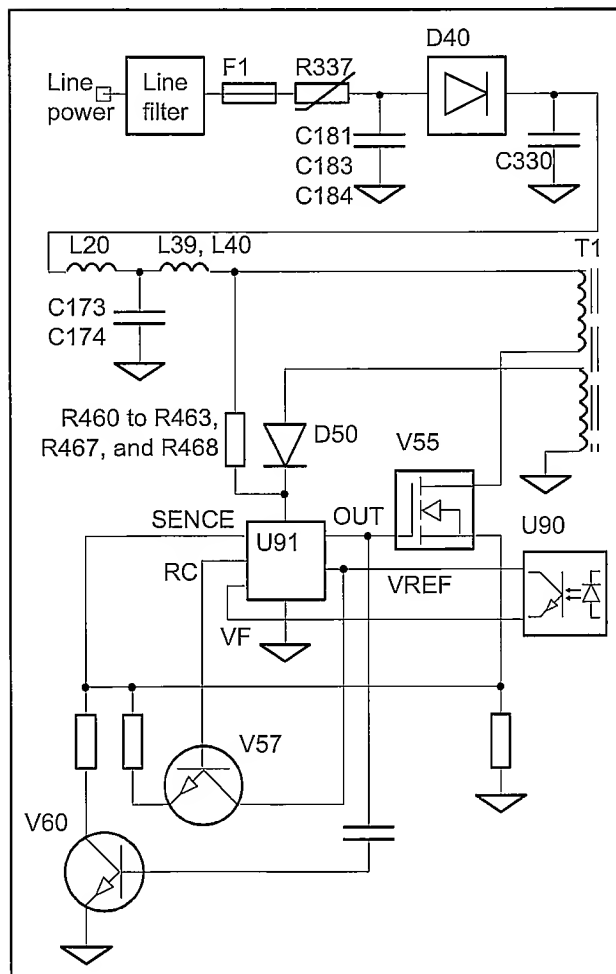


Figure 4-12 Power supply, primary circuits.

Used unregulated.

A relay (K1C) disconnects the load of the +5 V and -5.2 V at stand-by. Because the power circuits always must have a load on the regulated voltage, a bleeder resistor R349 is always connected to +5 V. At standby the counter only needs +12 V, and to get enough current of this voltage, a certain current of the regulated +5 V must be used.

The ON/STANDBY logic controls relay K1A, which operates as described above. J15 have three functions:

Removed K1A allways open.

Ground K1A allways closed.

The temperature is sensed by counter circuit U58 which outputs an analog signal to the μ -controller U6. The μ -controller also senses the temperature on the main PCA via

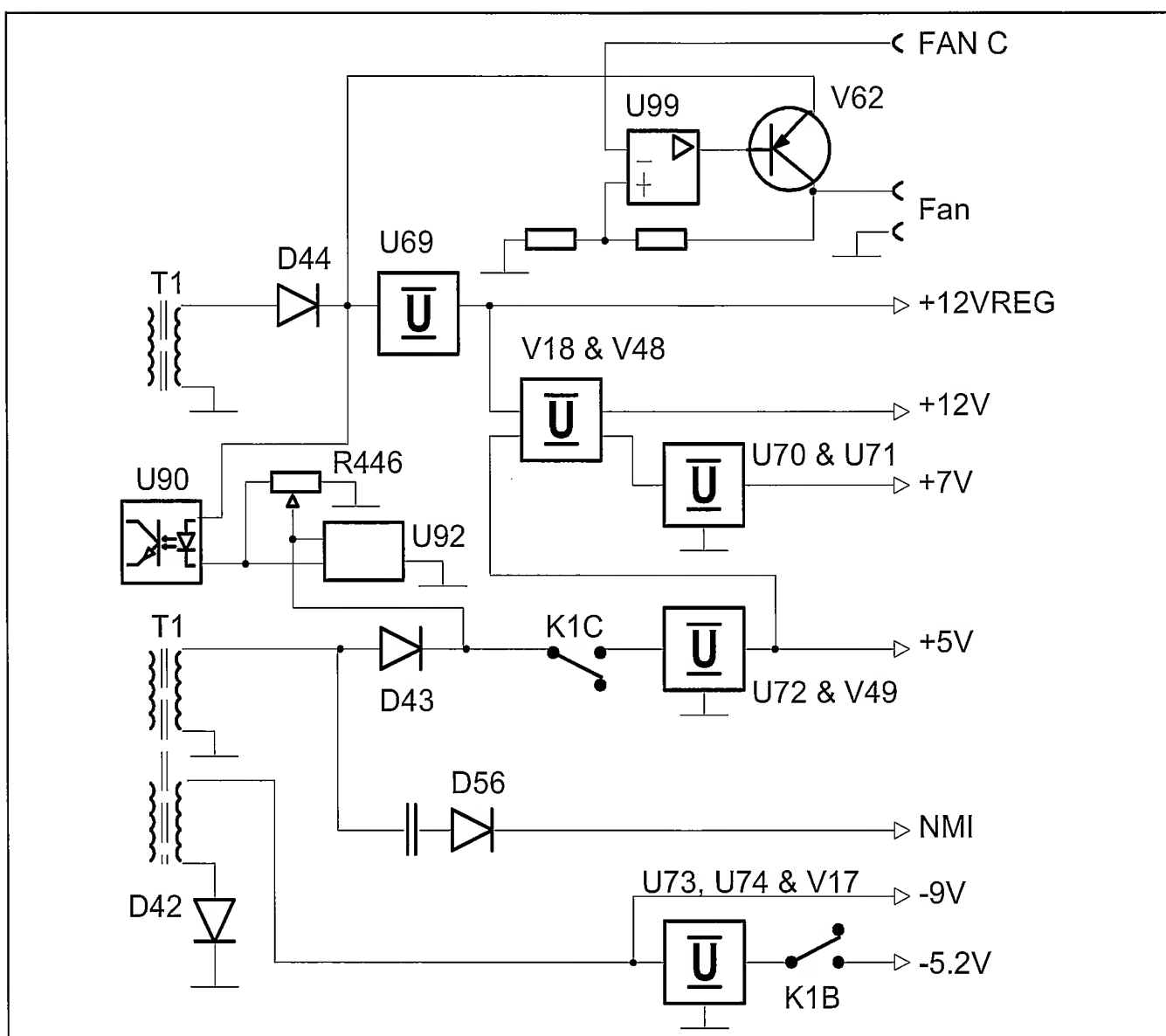


Figure 4-13 Power supply.

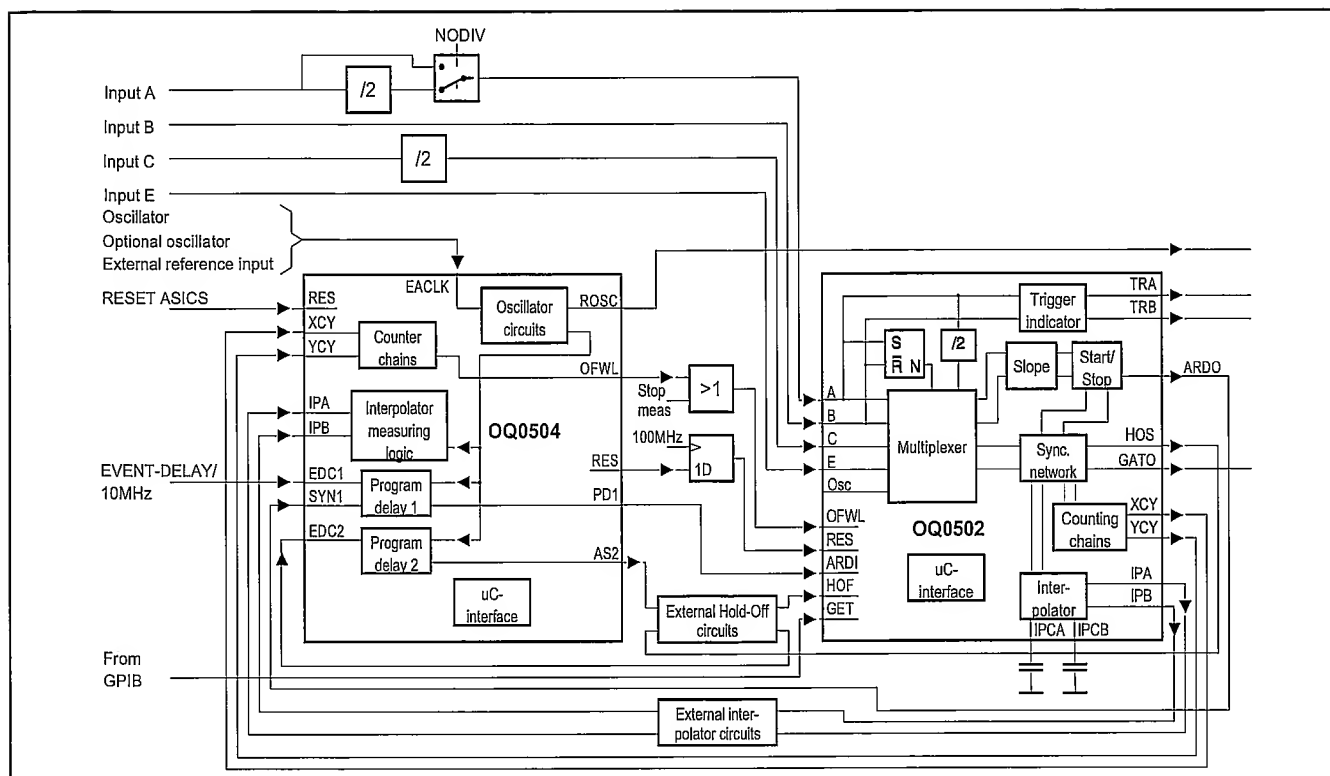


Figure 4-14 OQ0502 and OQ0504 block diagram.

the resistor R564 and then controls the fan via U99 and V62.

Counter Circuits

The PM 6681 measuring logic consists of two ASIC's: One high speed bipolar ECL circuit and one CMOS circuit. The bipolar SMTc, (U56) contains the measuring control functions, high speed counters and some analog parts used to increase the time resolution. The CMOS ASMTc, (U58) consists of two counter chains for the measurement and logic for measuring the expanded interpolator pulses. It also contains two programmable mono flip flops (100 ns resolution), an oscillator and an external reference input, (see Figure 4-16).

Interpolator

The bipolar circuit has a small analog part. This part increases the resolution in time and frequency measurements by means of an analog interpolator. An analog interpolator is basically a capacitor charged and discharged with different currents (ratio approximately 400). A small error pulse is extended with the ratio of these currents, (see Figure 4-14).

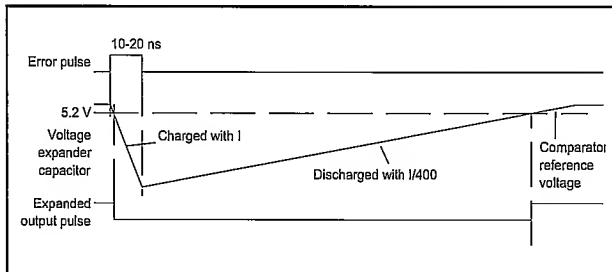


Figure 4-16 The interpolator expands the error pulse 400 times.

Using the standard clock frequency as a reference we can measure this new extended pulse length. There are two interpolators, one start and one stop interpolator. OQ0502, (U58) circuit includes the generation of the error pulse and the time expander. OQ0504, (U56) holds the measuring logic for the expanded pulse. The small error pulse is the time from the external trigger event to the second positive clock transition. Consequently, the error pulse is between 10 ns and 20 ns long. The extended pulse is approximately 3 to 7 μ s, (see Figure 4-15).

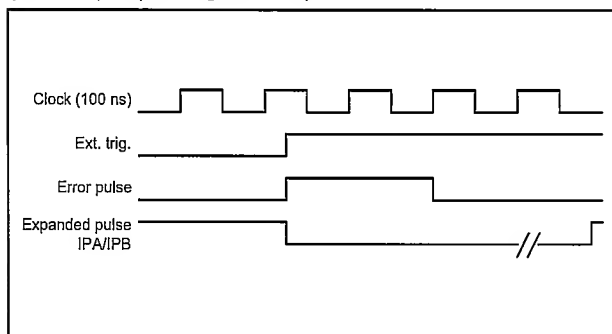


Figure 4-17 Measuring the expanded pulse in the OQ0504 and the external counter.

Very fast events can not be handled by the counter circuits. Therefore some external interpolator circuits have been added to the interpolator circuits located inside OQ0502, U58. The counter circuits, U39 and U41 are clock-

ed with 100 MHz when the signals IPA and IPB are present. After the counter circuit the signal is fed to OQ0504, U56, to be measured.

Timing

The following timing diagram (Figure 4-17) shows a number of measurement signals for a frequency measurement of 11 periods. This measurement is started directly when reset is released. The measurement start can be controlled in a much more detailed manner. GET and arming delays (event or time) can be used to qualify the measurement start. Qualifying the stop can be done in the same advanced way. The basic method is to send a Measurement STOp (MSTO) signal to the circuits via the μ C interface. This signal cannot be viewed externally.

The length of IPA and IPB is not correctly viewed (approximately 3 to 7 s).

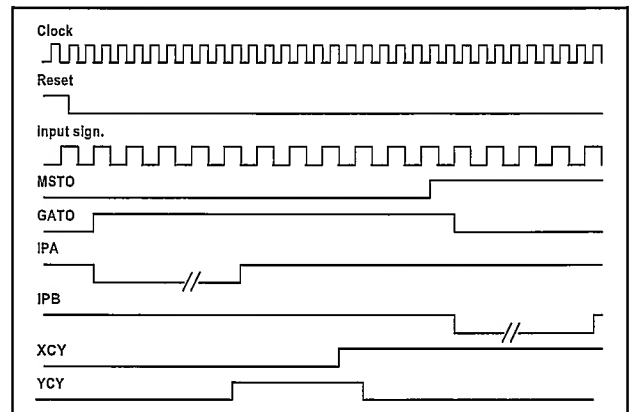


Figure 4-15 A number of measurement signals for a frequency measurements of 11 periods.

XCY (X carry) is the input signal divided by 8. YCY (Y carry) is the clock divided by 8 (12.5 MHz). These two signals will normally look like a burst signal of 12.5 MHz and the input signal divided by 8. The burst length is as long as the gate time. An OverFlow Warning message, OFLW is sent to the OQ0502 circuit. This means that the counter chains in OQ0504 will soon overflow and that the start/stop logic should stop the measurement when possible.

Reset

The RESET signal is coupled as a ripple through chain. By this method the reset signal resets the whole measuring logic in a correct order. The reset chain starts at the RESET IN pin on OQ0504, ripples through the measuring logic of OQ0504 and comes out on RESET OUT. The RESET signal is clocked through a flip-flop by the 100MHz signal and is then connected to the RESET IN pin of OQ0502 and resets the measuring logic of OQ0502.

The TRA and TRB signals are directly controlling the trigger LED's on the front panel. C315 and C316 connected to TRAC and TRBC inputs control the blinking rate.

Arming Delay

The measuring logic also has a programmable delay with a resolution of 100 ns. This delay is used as arming delay and is generated in the OQ0504. It is triggered from OQ0502 by the signal ARDO (to SYN1 in OQ0504). Toget-

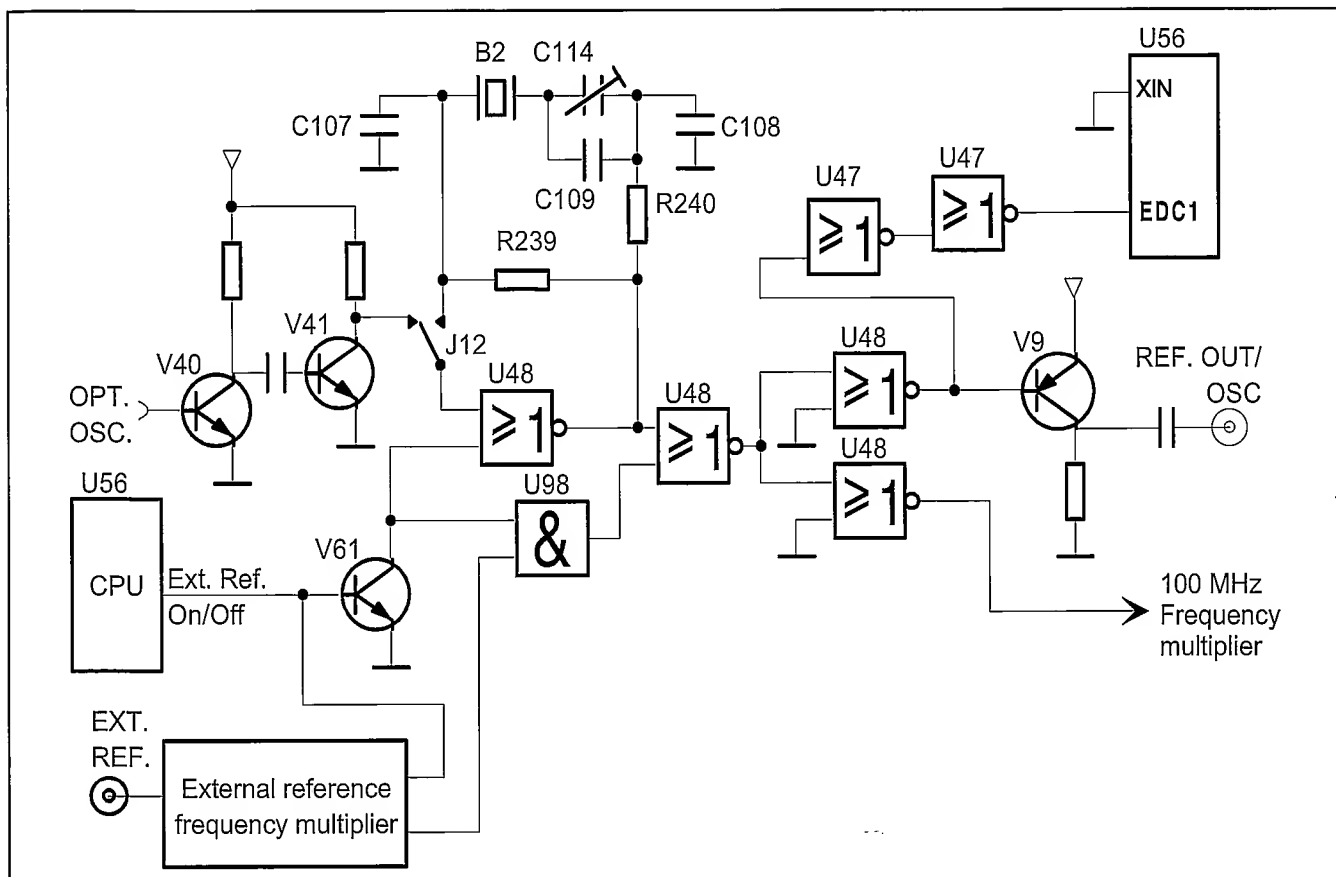


Figure 4-18 Oscillator circuits functional description.

her with the signal PD1 from OQ0504, the delayed signal is fed back to the ARDI input on OQ0502. Instead of a time delay, the delay can be programmed to an event delay. The EDC1 input of OQ0504 are therefore connected to the B input enabling, event delay for events on the B channel.

Hold-Off

A second programmable delay with a resolution of 10 ns is used as hold off. It is triggered from OQ0502 by the signal HOS. The counter U53 is loaded with a value and clocked with 100 MHz. When the counter has come to zero this information is sent to OQ0504, EDC2 and the circuits are re-set.

The delayed signal is fed back to the HOF input on OQ0502.

Gate Open

The signal GATO from OQ0502 gives a real time indication of the state of the measuring logic. Main gate open is indicated by a high level and main gate closed is indicated by a low level. V122 makes it possible to make the high level 1.4 V in 50Ω.

Divider

The signal from input A is divided by two during frequency A measurements by the divider U85. The reason for this is that the OQ0502 can not handle frequencies above 225 MHz.

To be able to measure frequency bursts also on input C the signal from the prescaler is divided by two by the other half of U85 before it enter the OQ0502..

Inputs

The signals A (A-channel), B (B-channel), C (prescaler signal), and E (rear panel external arming input) go to an input multiplexer in OQ0502. In OQ0502 the A and B inputs also have slope selections (positive edge and negative edge). R257 and C117 terminates the C signal.

External Arming

The rear panel input EXTERNAL ARMING is a DC-coupled TTL level input. R258 to R261 with D32 and D33 protects the input. V8 and V42 are a Schmitt-trigger with approximately 1.4 V threshold level. The external arming signal is connected to E input on OQ0502.

Burst

The signal HOS from OQ0502 are also used when measuring at bursts. The External Arming input is switched off by the signal HSO.4 from the μ -processor via V66 and V65. The HOS signal is then fed via V68 and V67 back to the OQ0502 input E.

All ECL-inputs in OQ0502 get their reference (VBB) from an external ECL-circuit U132.

The GET-signal from an optional GPIB-interface can control the start of the measurement.

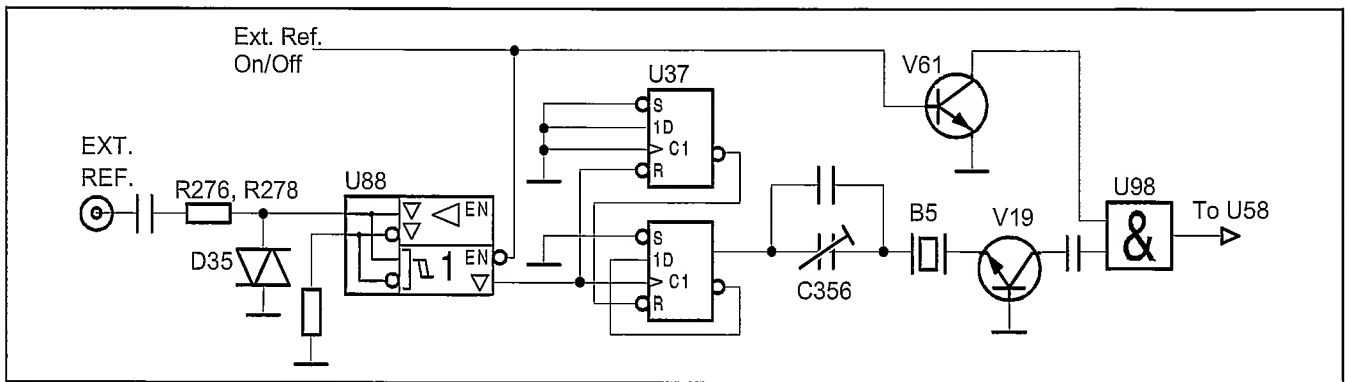


Figure 4-19 External reference circuits.

Oscillator Circuits

• CPU oscillator

The μ -controller U6 works with 16 MHz. A 16 MHz crystal B1 is connected to the XTAL inputs of the μ -controller. This frequency is divided by two by the μ -controller and is used by the GPIB controller U78.

• Standard oscillator

The 10 MHz reference oscillator is used as a reference for the measuring logic, (see Figure 4-18).

For the internal oscillator, there are several optional oscillators to choose from. The uncompensated 01-oscillator is always mounted in the PM 6681. If a better oscillator is needed, it should be connected to the opt.osc connector P105. A TCXO PM 9678B, oven oscillator PM 9690, or oven oscillator PM 9691 can be mounted. If this is done the oscillator type jumpers J12 should be placed in the OPT position.

The 01-oscillator consists of a crystal B2, C107 to C109, R239, R240, and the trim capacitor C114. C114 adjusts the frequency.

If an optional oscillator is mounted, the 10 MHz signal is amplified in a two stage amplifier (V40 and V41).

• External Reference Input

The external reference input can handle frequencies in steps from 1 MHz to 10 MHz, (1, 1.111, 1.25, 1.4285, 1.6667, 2, 2.5, 3.3333, 5, & 10 MHz).

R276, R278, and D35 protect the input. U88 amplifies the signal and make nice pulses out of it. U37 generates short pulses which is then filtered in the crystal filter B5 to be 10 MHz, (see Figure 4-19).

It is possible to switch off the external reference signal with the signal DISABL-EXT-REF from the micro controller. A low level of this signal makes V61 conductive, and that forces a high ECL-level on the output of U98.

The selected reference is used as 10 MHz out. An amplifier stage, V9 transforms the square wave from U56 to a sine signal. This stage has 50 Ω driving capabilities.

• 100 MHz Frequency Multiplier

The 10 MHz reference signal is fed to the flip-flops U81, which generates short negative pulses, (see Figure 4-20). These pulses triggers the resonant circuit, L25, C414, tuned to 100 MHz. After the amplifier V20, the signal is again fed to a resonant circuit, L29, C346, tuned to 100 MHz. A 100 MHz filter B3 removes over- and undertones. this procedure is repeated to get a nice sine wave. U94 generates a square wave signal which is used directly by the external Interpolator counter and Hold-off circuits. The 100 MHz square wave is also converted to ECL levels by resistors R238, R266, and R432, and used by OQ0502 as reference.

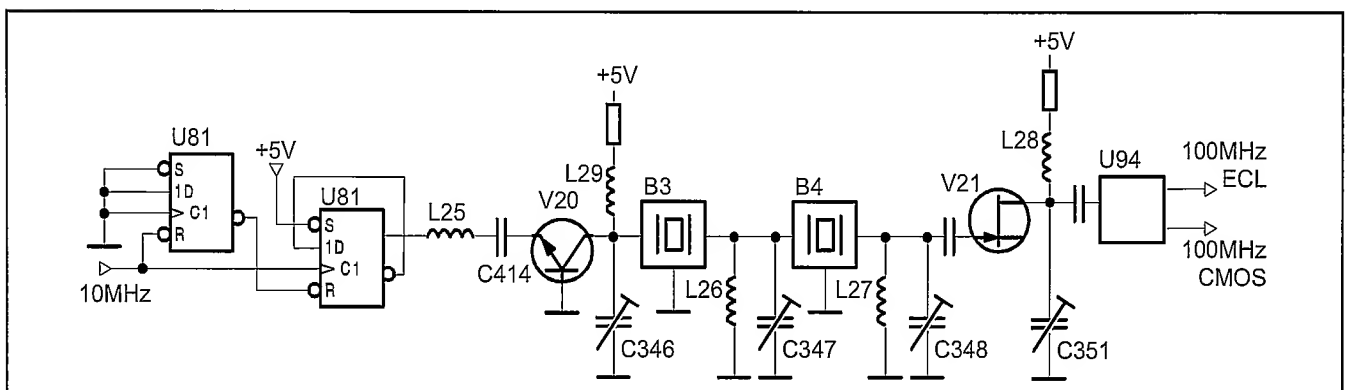


Figure 4-20 100 MHz frequency multiplier.

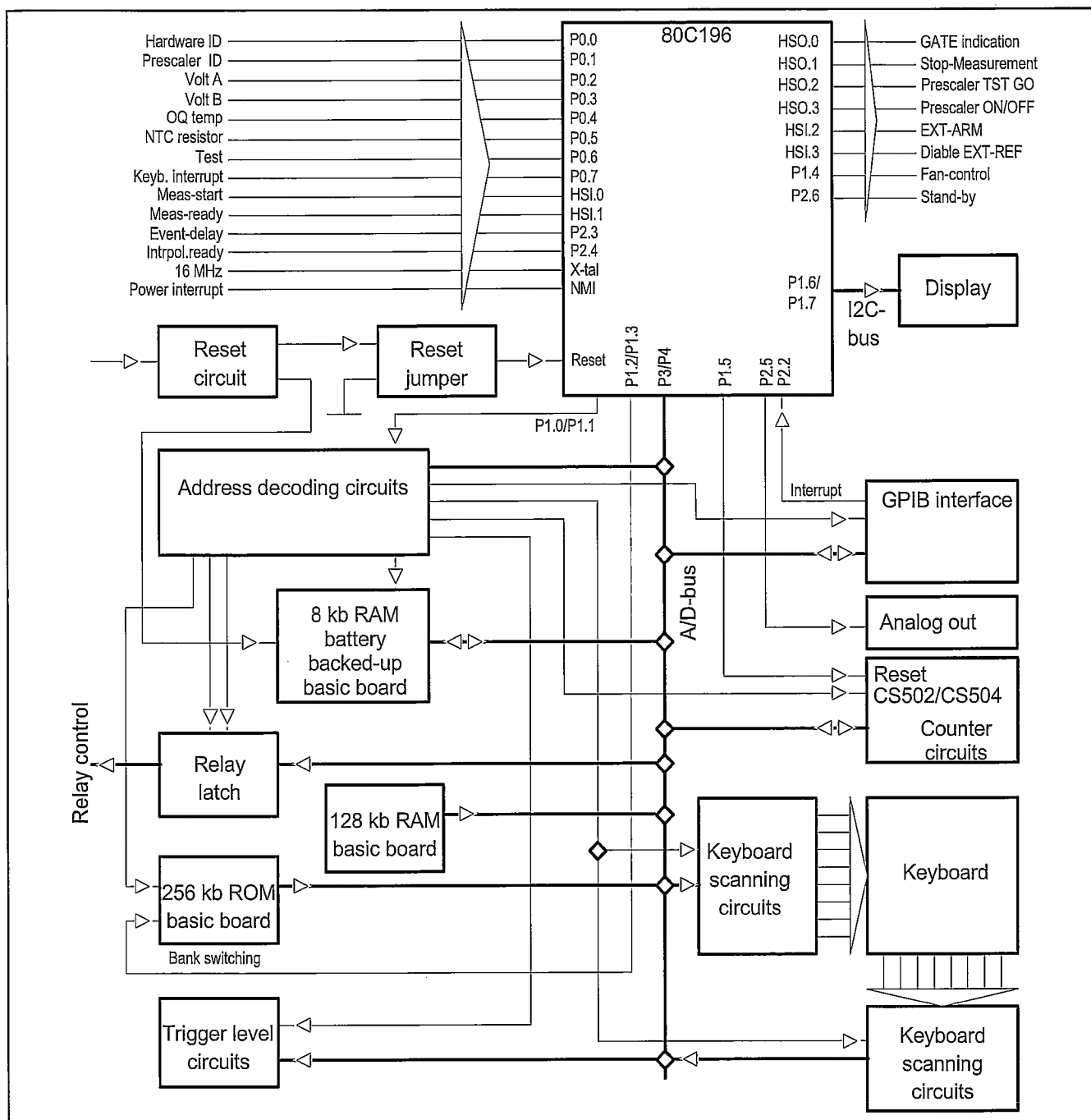


Figure 4-21 Block diagram, PM 6681 logical circuits.

Logical Circuits

• Microcomputer Circuits including I/O

The microcomputer in PM 6681 is an Intel 16-bit CHMOS μ controller 80C196KC16, U6. It is a fast micro controller, intended for controller applications, i.e., it has many I/O ports and other facilities to control and react on the external world. It contains 232 RAM-bytes, (see Figure 4-21).

The micro controller can operate in both 8 and 16-bits mode externally. Internally the micro controller uses 16-bits. The address and data-bus AD0 to AD15 is shared

(time multiplexed) between addresses and data. Therefore the address must be stored in an address-latch (U14 and U15) by using the signal ALE (pin 62).

If the surrounding circuits are slow compared to the micro controller, wait states must be issued. The ready-pin (pin 43) goes low to get wait states. When the micro controller communicates with the battery RAM, the GPIB-chip, the ASIC;s, and the trigger level circuits, wait states are automatically inserted.

The PROM;s (U16 and U17) used is a 27H010, i.e., two 128K byte memories. The address mapping is done so we can only address 32K bytes directly. Bank switching is

A special reset circuit is included in the design. U8 is a special supply supervisor. If the +5 V becomes lower than 4.5 V, the reset output pin 4 goes low. This gives a micro controller reset. For test purposes the micro controller can be forced to reset by short circuiting the pads J10. The length of the reset pulse is set by C310; 2.2 μ F gives a pul-

The STAND-BY indicator on the front panel is controlled by the +5 V, via V51. +5 V off lights the STAND-BY LED.

GPIB Interface

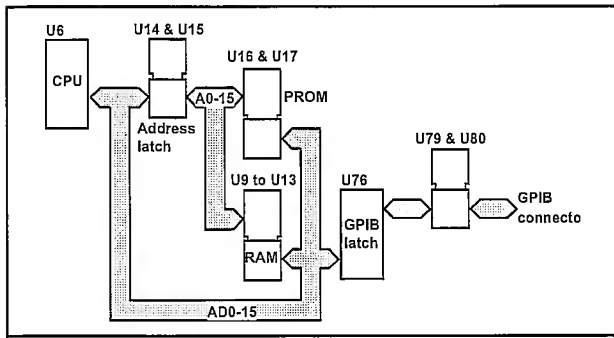


Figure 4-23 GPIB interface.

The GPIB interface controls the communication between the internal microprocessor and the external GPIB bus, (see Figure 4-23).

Communication between the GPIB control circuit, U78, and the external GPIB bus is done via the bi-directional bus drivers U79 and U80. U78 is controlled from the microprocessor by writing and reading in the internal control registers. If U78 has a message for the microprocessor, it uses the GPIB interrupt signal. The address of the GPIB bus is software controlled.

U9 to U13 are the RAM used to execute the program. U14 and U15 are address latches.

Analog Output

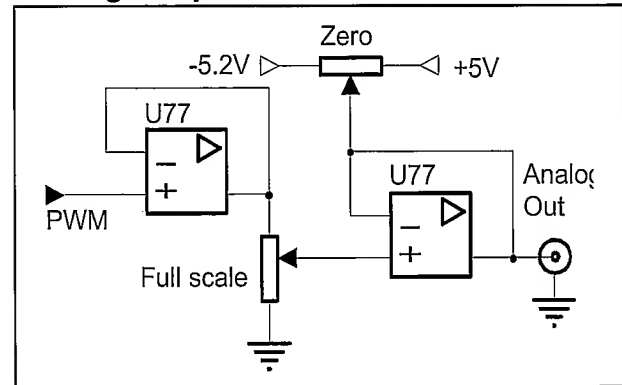


Figure 4-24 Analog output.

The result on the display can be converted to an analog signal. A digital pulse width modulated signal, PWM, from the microprocessor is filtered and integrated (U77) to give an analog DC level between 0 and 4.98 V with a resolution of 20 mV, (see Figure 4-24).

Rear Panel Unit

The rear panel consists of an aluminum panel with some mounted connectors, (see Figure 4-25). The following connectors are mounted on the rear panel:

INPUTS:

- External reference input - BNC (D)
- External arming input - BNC (E)
- Rear panel inputs (factory-mounted option)

– Power supply inlet including EMI filter

OUTPUTS:

- Internal reference output - BNC (G)
- Gate open output - BNC (H)
- Analog output (X).
- Probe compensation output.
- Trigger level output.
- A GPIB communication connector.

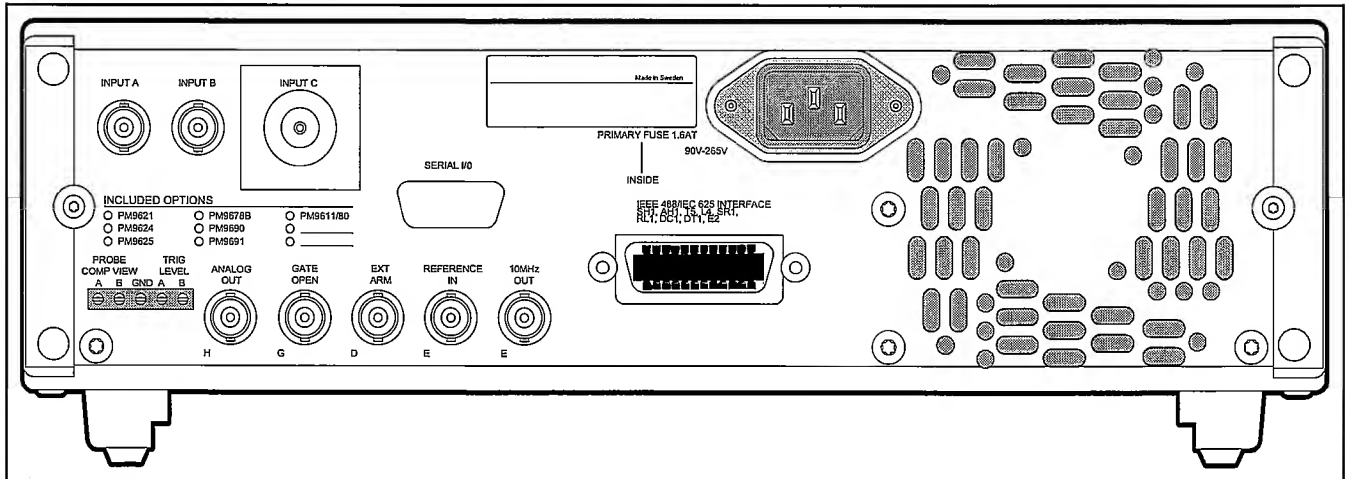


Figure 4-25 Rear panel.

Level detector

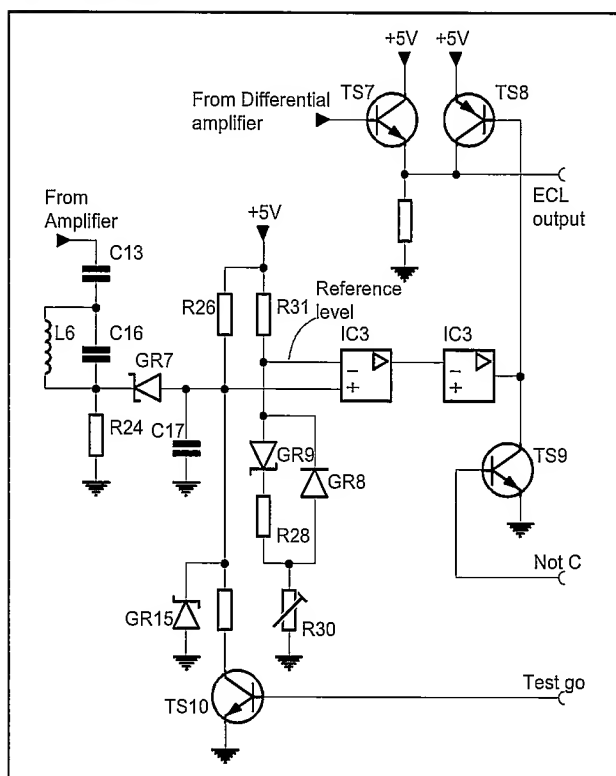


Figure 4-30 Level detector.

C13, C16, and L6 form a filter making the frequency response of the signal to the level detector diode GR7, the same as the signal to IC2, (see Figure 4-30).

The detector voltage is filtered and fed to IC3. Diode GR15 prevents the level from being too negative (IC3 is then locked). The first stage in IC3 amplifies the level approximately 15 times and the second stage is a Schmitt trigger. The output from the Schmitt trigger can block, via TS8, the ECL output signal. A low output signal from IC3 pin 7 makes TS8 conduct. The ECL output signal will be 4.5 V. If IC3 pin 7 is high, TS8 is not conducting, and the output signal from TS7 is not blocked. The Schmitt trigger is controlled from the first amplifier in IC3. If the level on IC3 pin 3 (detected level) is lower than the reference level on IC3 pin 2 (an HF signal with sufficient level present), IC3 pin 1 is low and the Schmitt trigger output is high, thus not blocking the ECL output signal. The reference level on IC3 pin 2 is set by trim-potentiometer R30. GR8, GR9, and R28 form a temperature compensation circuit, to compensate for the temperature behavior of the detector diode GR7. For testing purposes, the level detection can be overruled by the signal TEST GO. A high level makes TS10 conduct, and that enables the ECL output signal, despite the HF input signal amplitude. The ECL output signal can also be switched off, despite the level detection. A high level on signal NOT C makes TS9 conduct and thus makes the level to TS8 low. TS8 makes the ECL output signal +4.5 V.

• Prescaler 2.7 GHz, PM 9624

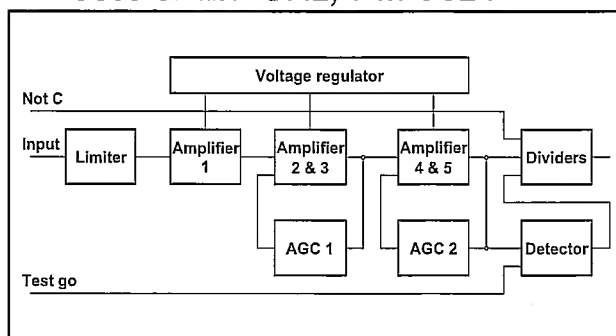


Figure 4-31 PM 9624 Block diagram.

The PM 9624 prescaler cannot be repaired at a local workshop. It must be sent to the factory for repair.

The prescaler consists of the following parts, (see Figure 4-31):

Limiter

- The limiter consists of a 6 dB attenuator and a PIN diode attenuator, to achieve constant input amplitude to the amplifiers.

Amplifier

- Five amplifier stages are divided into three blocks. One block consists of one amplifier. Two blocks consists of two amplifiers each and an AGC control.

Automatic Gain Control (AGC)

- Helps the amplifiers to retain a constant output amplitude.

Dividers

- Two dividers divide the input signal frequency by 16.

Detector

- Detects whether the level of the input signal is high enough to ensure correct measurement and, if not, blocks the output signal from the prescaler.

Positive Voltage Regulator

- Positive voltage supply for the amplifiers.

• Prescaler 4.5 GHz, PM 9625

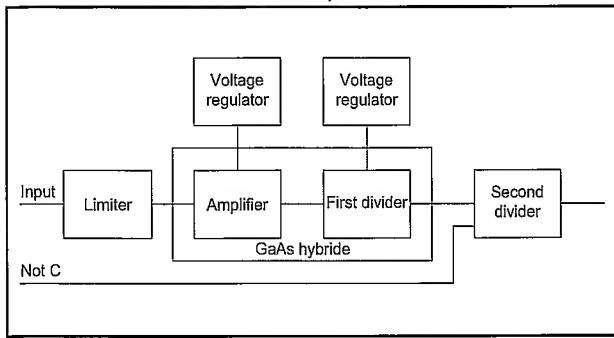


Figure 4-32 PM 9625 Block diagram.

The PM 9625 prescaler cannot be repaired at a local workshop. It must be sent to the factory for repair.

The prescaler consists of the following parts, (see Figure 4-32):

Limiter

- The limiter consists of a 6 dB attenuator and a PIN diode attenuator, to achieve constant input amplitude to the amplifiers.

Amplifier

- The amplifier consists of 4 cascade coupled integrated GaAs amplifiers; each amplifies approximately 8 dB.

First divider

- The GaAs divider chip consists of an input buffer, 3 divider stages, and 2 output buffer stages. The circuit divides by 8.

Second divider

- This divider divides the signal from the first divider by 4. In total the frequency is divided by 32, and the output frequency from the prescaler is 155 MHz at maximum.

Voltage regulators

- Two positive voltage regulators are used for the GaAs amplifier and the first divider.

Test Routines

Test Routines via AUX MENU Key

The test routines are the routines accessible via the aux menu key.

Refer to the PM 6681 Operators Manual.

Power-On Tests

At power on, some tests are automatically performed. Simultaneously a message is sent to the serial port of the μ -computer. The message can be read by a PC connected to the serial port. To do this perform as follows:

- Connect testpoints P5=OUT and P16=GND to a COM port on the PC.
- Run a terminal emulator program as KERMIT or Windows TERMINAL EMULATOR.

Switch on the counter.

Every time the counter is switched on the following message will be displayed on the screen:

Code start OK

Ram regs OK

Timer1 OK

Prom bank3 OK

Prom bank2 OK

Prom bank1 OK

Prom bank0 OK

Disp. Driver 1 OK

Disp. Driver 0 OK

Disp. Driver fill

Ram bank2, 2080h xor OK, 4000h fill OK

Ram bank1, 2080h xor OK, 2080h fill OK, 4000h fill OK

Ram bank0, 2080h xor OK, 2080h fill OK, 4000h fill OK

Ram bank2, 4000h zero OK, C000h zero OK

Ram bank1, 2080h zero OK, 4000h zero OK

Ram bank0, 2080h zero OK, 4000h zero OK

Asics, 0291h, 02A5h OK

PHILIPS, PM6681, 0, MAIN X1.02 Mar 24 1994 10:30:26 /
 GPIB X1.13 Mar 01 1994 123

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Chapter 5

Repair

Preventive Maintenance

Calibration

To maintain performance of PM 6681 we recommend that you calibrate your instrument every year, or more often, if greater time base accuracy is required. Calibration should be performed with traceable references and instruments at a certified calibration laboratory. Contact your local Fluke service center for calibration.

To know the present status of your instrument, test your timer/counter from time to time. The test can be made according to the information in Chapter 2, Performance Check.

Oscillators

The frequency of the reference crystal oscillator is the main parameter affecting accuracy in a counter. The frequency is affected by external conditions like the ambient temperature and supply voltage, but also by aging. When recalibrating, the reference crystal oscillator is compensated only for deviation in frequency due to aging.

• Some important points:

- The high stability oscillators have been built into an oven in order to keep the oscillator temperature as stable as possible. Continuous operation is also important for stability. After a power interruption, the oscillator restarts at a slightly different frequency. It will then, as time goes on, age at an equal rate.
- The stability indicated for the oscillators is valid within a temperature range of 0 to 50°C, with a reference temperature of 23°C. If the timer/counter is used in a room temperature of 20 to 30°C, the temperature stability of a TCXO or OCXO will be increased by a factor of 3.
- The temperature stability indicated for TCXO and standard oscillators are mainly dependent on the ambient temperature. When operating there is always a temperature increase inside the counter which will influence the oscillator.

• Recalibration intervals

The Mean Time Between ReCalibration, MTBRC, is defined as:

$$MTBRC = \frac{(\text{Acceptable error}) - (\text{Temperature stability})}{(\text{Aging})}$$

MTBRC can be calculated when the total acceptable error and the oscillator specifications are known.

The total acceptable error is defined as:

$$(\text{Acceptable error}) = \frac{(\text{Deviation of reference frequency})}{(\text{Nominal frequency reference})}$$

Example:

- A user can accept a maximum of 3 Hz deviation on the 10 MHz frequency of the oscillator. This results in:

$$(\text{Acceptable error}) = \frac{3}{10 \times 10^6} = 3 \times 10^{-7}$$

The aging and temperature factors can be selected from the table on page 5-3.

The value of the aging factor is correctly selected from the table when the calculation of MTBRC results in 1 to 30 days (use /24h), 1 to 12 months (use /month) or over 1 year (use /year) (not, e.g., 43 days or 17 months or 0.8 years).

Example:

- The user has the same requirements as in the example above. The counter has a PM 9690 oscillator.
- Look up information about PM 9690 in the table on page 5-3. The results will be the following:

Relative Frequency deviation caused by:

- Ambient temperature deviation
(within 0 to 50°C; reference point at 23°C): Less than 1.5×10^{-8}
- Aging/year: Less than 1×10^{-7}
- Use the MTBRC formula with the above values. This gives a MTBRC of maximum:

$$\frac{(3 \times 10^{-7}) - (1.5 \times 10^{-8})}{1 \times 10^{-7}} = 2.9 \text{ year}$$

See also Figure 5-1, Figure 5-2, and Figure 5-3.

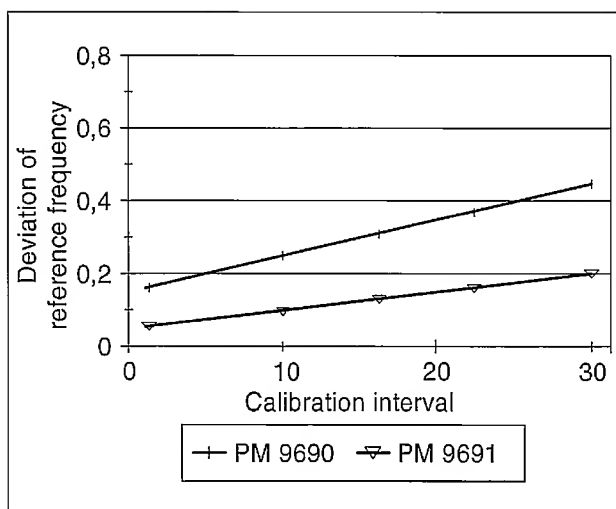


Figure 5-1 MTBRC in days.

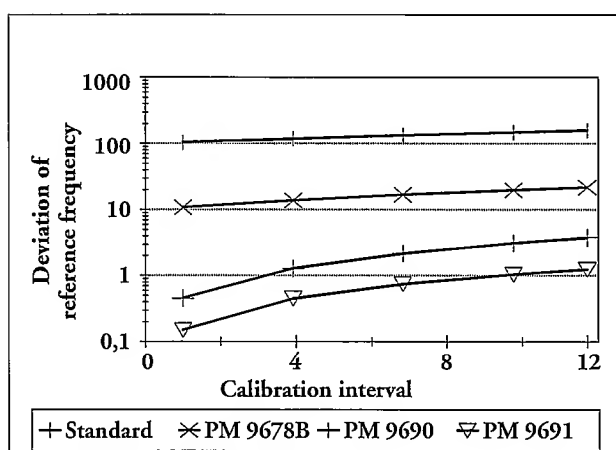


Figure 5-2 MTBRC in months.

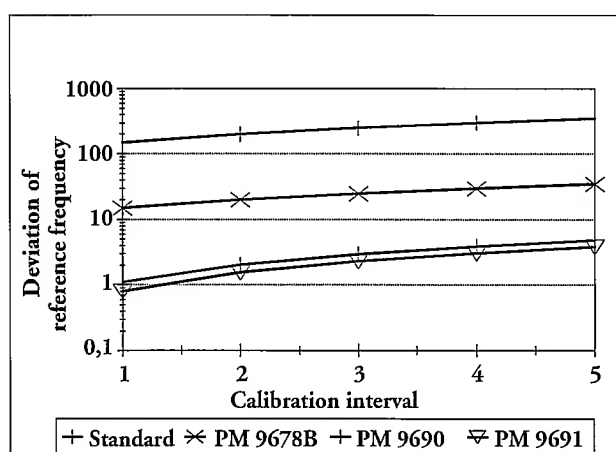


Figure 5-3 MTBRC in years.

NOTE: When recalibrating, the reference crystal oscillator will be compensated only for frequency deviation caused by aging.

| Stability against | Model Options | | | |
|--|----------------|----------------|------------------|-------------------|
| | /1. | /2. | /4. | /5. |
| | | PM 9678B | PM 9690 | PM 9691 |
| | Standard | TCXO | Oven | Oven |
| Aging: /24h | n.a. | n.a. | $<1 * 10^{-9}$ * | $<5 * 10^{-10}$ * |
| Aging: /month | $<5 * 10^{-7}$ | $<1 * 10^{-7}$ | $<2 * 10^{-8}$ | $<1 * 10^{-8}$ |
| Aging: /year | $<5 * 10^{-6}$ | $<5 * 10^{-7}$ | $<1 * 10^{-7}$ | $<7.5 * 10^{-8}$ |
| Temperature: 0 to 50°C ref. to + 23°C | $<1 * 10^{-5}$ | $<1 * 10^{-6}$ | $<1.5 * 10^{-8}$ | $<5 * 10^{-9}$ |
| Line Voltage \pm 10% | $<1 * 10^{-8}$ | $<1 * 10^{-9}$ | $<5 * 10^{-10}$ | $<5 * 10^{-10}$ |
| Warm-up Time to Reach 10^{-7} of Final Value | n.a. | n.a. | < 15 min | < 15 min |

Table 5-1

* after 48 hours of continuous operation

Battery Replacement

To preserve data and variables needed for the use of PM 6681 a lithium battery is included. The lithium battery has an estimated lifetime of five to ten years. We recommend replacing the battery every five years to avoid loss of data in operation.

When battery is empty, the timer/counter will lose all settings, and any data in memory, if disconnected from line power.

See "Reinstalling the Battery" on page 3-4.

Troubleshooting

General

Quick Troubleshooting

The PM 6681 is a highly integrated Timer/Counter with dedicated LSI counter circuits and microcontrollers that control the complete units. The microcontroller can help you to locate faulty parts by running test programs and generating stable signal patterns on the bus. If the microcontroller does not work or the fault is in a part of the counter that cannot be accessed by the microcontroller, traditional fault-finding must be performed.

Where to Start

After reading the safety instructions, continue with this Chapter for faultfinding and repair instructions. When you have fixed the instrument, always do the Safety Inspection and Test after Repair, as described later in this Chapter. Then do the checks in Chapter 2, Performance Check. Recalibrate if required by following the adjustment instructions in Chapter 6, Calibration Adjustments.

Logical Levels

The PM 6681 contains logic of four families. The levels for these families are listed in Table 5-2.

| | Positive ECL | Negative ECL | CMOS | TTL |
|-----------------------------|-----------------|-----------------|------------|-----------|
| Supply voltage | +5 V | -5 V | +5 V | +5 V |
| Signal ground | 0 V | 0 V | 0 V | 0 V |
| Input voltage | | | | |
| High, V_{IH} | $>+3.9$ V | >-1.1 V | $>+4$ V | $>+2$ V |
| Low, V_{IL} | $<+3.5$ V | <-1.5 V | $<+1$ V | $<+0.8$ V |
| Output voltage | | | | |
| High, V_{OH} | $>+4$ V | >-1 V | $>+4.9$ V | $>+2.7$ V |
| Low, V_{OL} | $<+3.3$ V | <-1.7 V | $<+0.05$ V | $<+0.4$ V |
| Bias ref. voltage, V_{BB} | +3.7 V | -1.3 V | - | - |

Table 5-2 Logical levels.

Required Test Equipment

To be able to test the instrument properly using this manual you will need the equipment listed in Table 5-3. The list contains not only suggested Fluke test equipment, but also the critical parameter specifications required if you have instruments from other manufacturers.

| Type | Performance | Model No |
|------------------|------------------|---------------|
| DMM | - | PM 2518 or 77 |
| Oscilloscope | 50 Mhz 2-channel | PM 3050 |
| Signal generator | 1300 MHz | 6062A |
| BNC-BNC cables | - | - |

Table 5-3 Required test equipment.

Operating Conditions

Power voltage must be in the range of 90 to 260 VAC.

Introduction

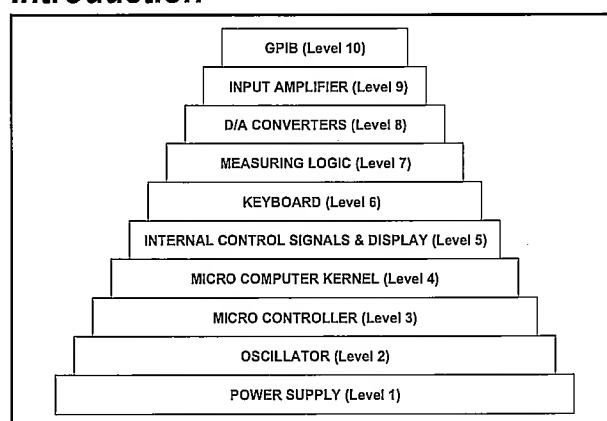


Figure 5-4 Functional levels.

The troubleshooting strategy in PM 6681, is an integrated part of the overall service strategy for the instrument. This instrument is hierarchically designed in different levels, see Figure 5-4, and troubleshooting can be performed in any design level if the lower levels are OK. It is therefore important to disconnect all options in the beginning of the troubleshooting procedure.

Running Test Programs

The service functions are activated by connecting the two solder points, labeled TEST, J11 during startup, see Figure 5-6.

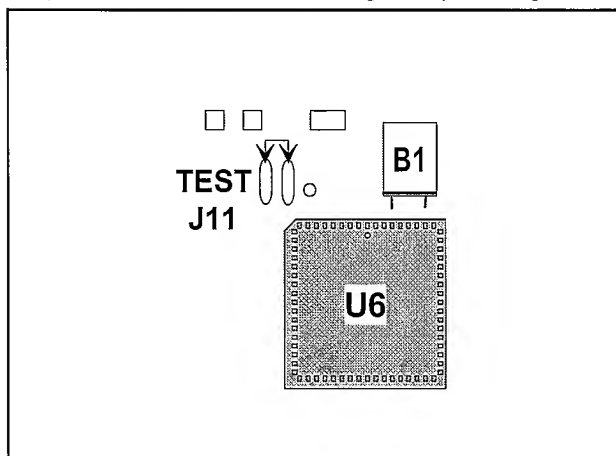


Figure 5-6 The service functions are activated by connecting the two solder points, labeled TEST, J11 during startup.

— Switch on the counter.

The ROM test, RAM test, and μ C Kernel test runs automatically. After the display test the test-program starts from the beginning again. Use LOCAL/PRESET to step through the different tests.

NOTE: The address test and display test are described under Level 4 and Level 5 respectively, but they cannot be run before you have checked Level 6.

| Text | Function | Level | Exit |
|------------|---------------------|-------|---------------|
| test rO | ROM test | 3 | Automatically |
| test rA | RAM test | 3 | Automatically |
| test Core | μ C Kernel test | 3+4 | LOCAL/PRESET |
| test relay | Control signal test | 5 | LOCAL/PRESET |
| test buttn | Keyboard test | 6 | LOCAL/PRESET |
| test Addr. | Address test | 4 | LOCAL/PRESET |
| test ASIC | ASIC's test 1 | 7 | Automatically |
| test ASIC | ASIC's test 2 | 7 | LOCAL/PRESET |
| test dAC | DAC test | 8 | LOCAL/PRESET |
| test ANALO | Analog out test 1 | 10 | LOCAL/PRESET |
| 85 | Analog out test 2 | 10 | LOCAL/PRESET |
| 8888888888 | Display test | 5 | LOCAL/PRESET |

Table 5-4 Test programs.

Troubleshooting Tree

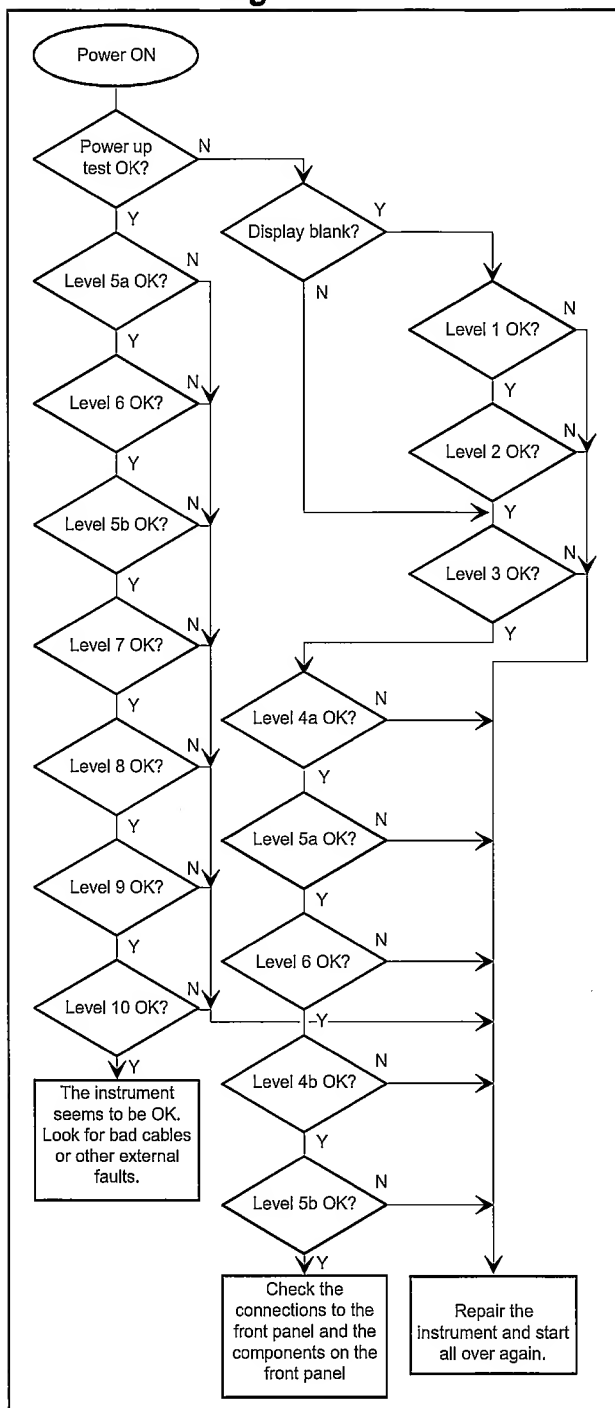


Figure 5-5 Troubleshooting tree.

The levels mentioned in the troubleshooting tree refer to the functional levels in Figure 5-4. For example Level 3 are equal to Microcontroller (3). (Do the microcontroller check later in this Chapter.)

Power Supply (Functional Level 1)

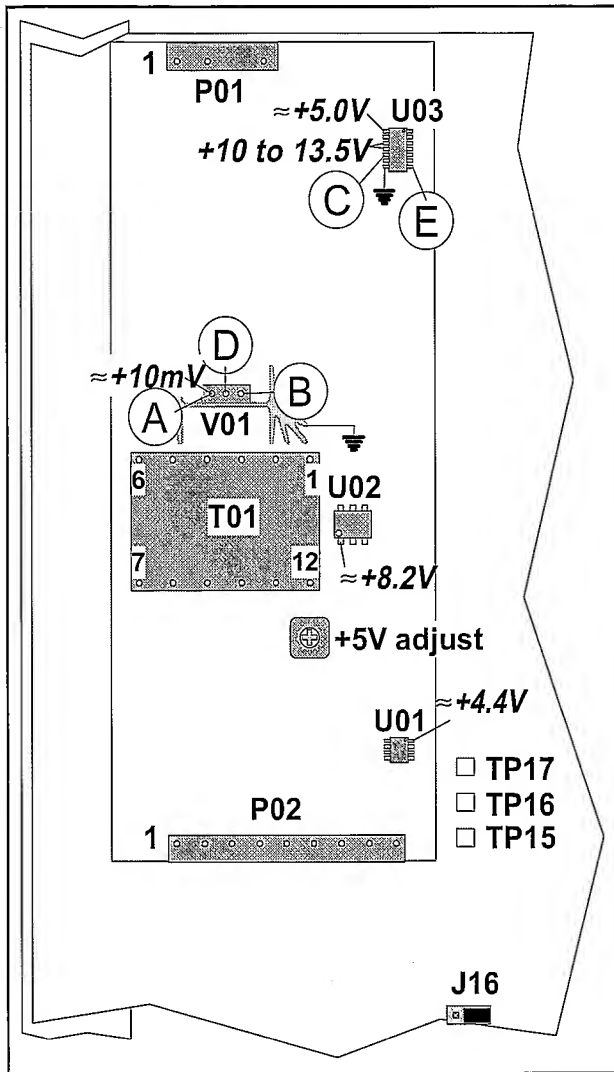


Figure 5-7 Test points and voltages for the power supply.

WARNING: Live parts and accessible terminals which can be dangerous to life are always exposed inside the unit when it is connected to the line power. Use extreme caution when handling, testing or adjusting the counter.

Primary circuits

To verify the Power supply proceed as follows:

- If the primary fuse is broken, there is a short circuit in the primary circuits. Use a DMM and try to locate the fault by resistance measuring.
- Remove the cover from the Power Supply.

WARNING: The heat sink inside the power supply is connected to the line power.

- Disconnect L39 and L40 and check the resistance between pin 1 and 4 on the transformer T1, see Figure 5-7. If the DMM show a short circuit the fault is probably a broken transistor V55. Put L39 and L40 back in position.
- Connect the counter to the line power via an insulating transformer with separate windings.
- Set the counter to STAND-BY mode.
- Check that the voltage between P19 and P23 is in the range of 90 to 260 VAC.
- Check that the DC voltage between pin 1 and 4 on T1 is about $\sqrt{2}$ times the input AC-voltage. If not, use traditional faultfinding techniques to locate the fault.
- Remove the jumper J15.
- Check the "STAND BY" voltages according to Table 5-5.

| Test points | Ground | Voltage |
|-----------------|-----------|-------------------|
| U91 pin 11 & 12 | U91 pin 8 | +10 to +13.5 V |
| U91 pin 14 | U91 pin 8 | ≈+5.0 V |
| V55 source | U91 pin 8 | ≈+10 mV |
| U90 pin 1 | L41 | ≈+8.2 V |
| U92 pin 1 | L41 | ≈+4.4 V |
| X10 | L41 | ≈+5.1 V |
| X11 | L41 | +14.8 V to +21 V |
| X12 | L41 | –12.5 V to –7.5 V |
| X13 | L41 | +12 V ±0.5 V |

Table 5-5 Stand-by voltages.

- Reinstall the jumper J15.
- Check the curveforms according to Figure 5-8 and Figure 5-7 to verify the primary circuits. Use the heat-sink of V55 as ground.

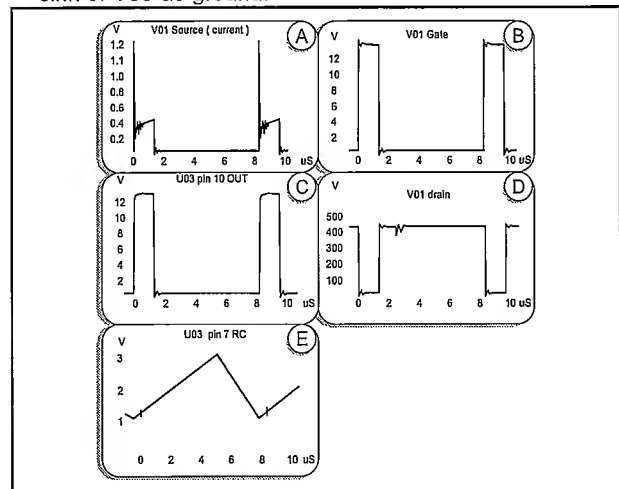


Figure 5-8 Typical curves of the power supply.

NOTE: U91 and U92 are located at the bottom side of the PCA.

Secondary circuits

- Connect the power cable to the counter.
- Switch ON the counter.

CAUTION: If you adjust the +5 V trimmer you have to adjust the complete instrument.

- Check the "POWER ON" voltages according to Table 5-6. Use L41 as ground.

| Test points | Voltage |
|-------------|----------------------|
| X15 | +5.01 V \pm 30 mV* |
| X16 | –5.1 V \pm 50 mV |
| X14 | +7 V \pm 100 mV |
| X17 | +12 V \pm 100 mV |

Table 5-6 Power-on voltages.

*NOTE: If the +5 V voltage is outside the specification, all other levels will be wrong, since they are based on the +5 V level.

If you find any fault, continue with traditional troubleshooting techniques and replace defective circuits. See also Chapter 4, Circuit Descriptions, Power Supply.

Oscillator (Functional Level 2)

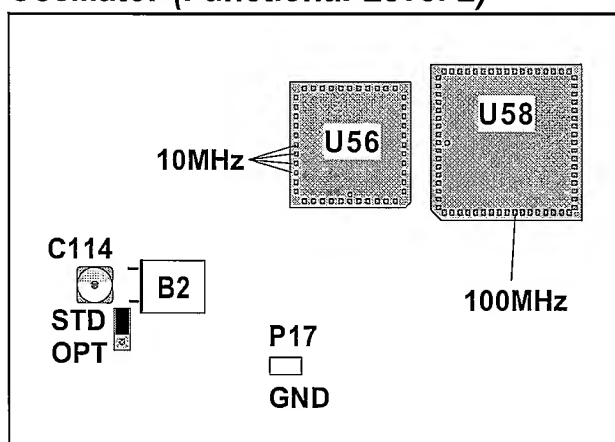


Figure 5-9 Test points and jumper for testing the oscillators.

• Standard Oscillator

- Be sure that jumper J12 are in the STD position, see Figure 5-9.

- Check that 10 MHz is present at U56 pins 34, 35, 36 and pin 37.
 - Check that 10 MHz is present at the rear panel connector 10 MHz OUT, J7.
 - Check that 100 MHz is present at U58 pin 19.
- If you find any fault, continue with traditional troubleshooting techniques and replace defective circuits. See also Chapter 4, Circuit Descriptions, Oscillator Circuits.

• Optional Oscillator, PM 9678B

This test can be carried out only if the counter is equipped with an optional oscillator, PM 9678B.

- Be sure that jumper J12 are in the OPT position, see Figure 5-9.
 - Check that 10 MHz is present at U56 pins 34, 35, 36 and pin 37.
 - Check that 10 MHz is present at the rear panel connector 10 MHz OUT, J7.
 - Check that 100 MHz is present at U58 pin 19.
- If you find any fault, continue with traditional troubleshooting techniques and replace defective circuits. See also Chapter 4, Circuit Descriptions, Optional Oscillator, PM 9678B.

• Optional Oscillator, PM 9690 and PM 9691

This test can be carried out only if the counter is equipped with an optional oscillator, PM 9690 or PM 9691.

- Be sure that jumper J12 are in the OPT position, see Figure 5-9.
 - Check that 10 MHz is present at U56 pins 34, 35, 36 and pin 37.
 - Check that 10 MHz is present at the rear panel connector 10 MHz OUT, J7.
 - Check that 100 MHz is present at U58 pin 19.
- These oscillators cannot be repaired in a local workshop. They must be sent to the factory for repair.

Microcontroller (Functional Level 3)

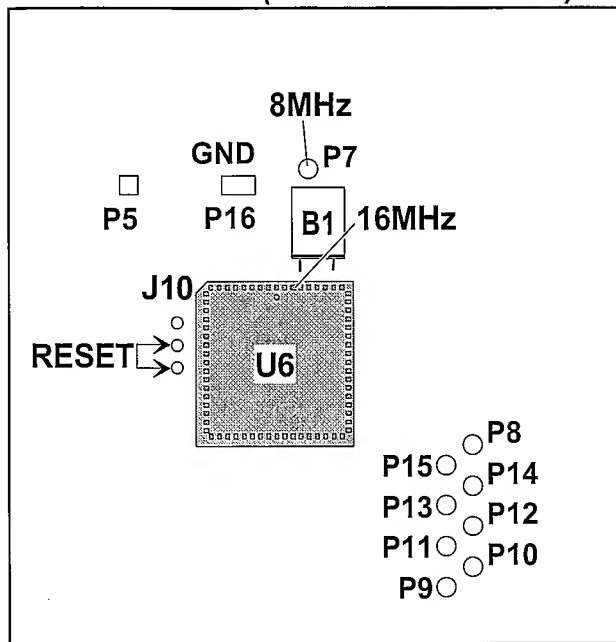


Figure 5-10 Test points and jumpers for testing the microcontroller.

- Check that 16 MHz is present at U6 pin 67, see Figure 5-10.
- Check that 8 MHz is present at P7.
- Check that the RESET circuitry U8 works properly by short circuiting the above shown pads.

At power on, some tests are automatically performed. Simultaneously a message is sent to the serial port of the μ -computer. The message can be read by a PC connected to the serial port. To do this perform as follows:

- Connect testpoints P5=OUT and P16=GND to a COM port on the PC.
- Run a terminal emulator program as KERMIT or Windows TERMINAL EMULATOR.
- Switch on the counter.

Every time the counter is switched on the following message will be displayed on the screen:

Code start OK

Ram regs OK

Timer1 OK

Prom bank3 OK

Prom bank2 OK

Prom bank1 OK

Prom bank0 OK

Disp. Driver 1 OK

Disp. Driver 0 OK

Disp. Driver fill

Ram bank2, 2080h xor OK, 4000h fill OK

Ram bank1, 2080h xor OK, 2080h fill OK, 4000h fill OK

Ram bank0, 2080h xor OK, 2080h fill OK, 4000h fill OK

Ram bank2, 4000h zero OK, C000h zero OK

Ram bank1, 2080h zero OK, 4000h zero OK

Ram bank0, 2080h zero OK, 4000h zero OK

Asics, 0291h, 02A5h OK

PHILIPS, PM6681, 0, MAIN X1.02 Mar 24 1994 10:30:26 /

GPIO X1.13 Mar 01 1994 123

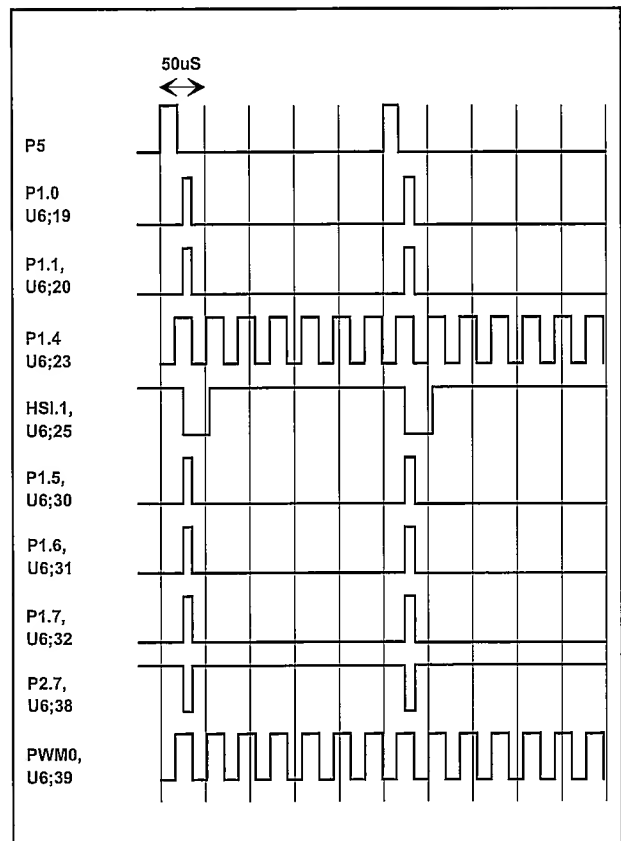


Figure 5-11 Timing diagram for μ -controller.

- Run μ C Kernel test, Test 3.
- Set the oscilloscope to 0.2 V/div and 50 μ s/div.
- Check the output signals from the μ C, U6, see Figure 5-10. Use test pin P5 to trigger the oscilloscope.
- The timing diagram, Figure 5-11, shows the signals generated by the stimuli program.

If you find any fault, continue with traditional troubleshooting techniques and replace defective circuits. See also Chapter 4, Circuit Descriptions, Logical Circuits.

NOTE: Check that activity is going on at U6 pin 62 (ALE), U6 pin 61 (RD), U6 pin 63 (INST), U6 pin 40 (WR/WRL), U6 pin 41 (BME/WRH), and U6 pin 43 (READY). These pins should not be stuck to HIGH or LOW.

- If one or more bits on the AD-bus are corrupt, the μ C often reads the same instructions repeatedly. When the μ C discovers are invalid OP code, it will RESET itself and start from the beginning again. The μ C sets the RESET input low when it resets itself. This can be discovered at the RESET input of U6, (pin 16). If +5 V to U8 is OK, this could be the case.

Microcomputer Kernel (Functional Level 4a)

Set the oscilloscope to 2 V/div and 20 μ s/div.

- Run μ C Kernel test, Test 3.
- Check all signals on U9 to U13, U16 and U17. The signals should not be stuck high or low. Use test pin P5 to trigger the oscilloscope, see Figure 5-12.

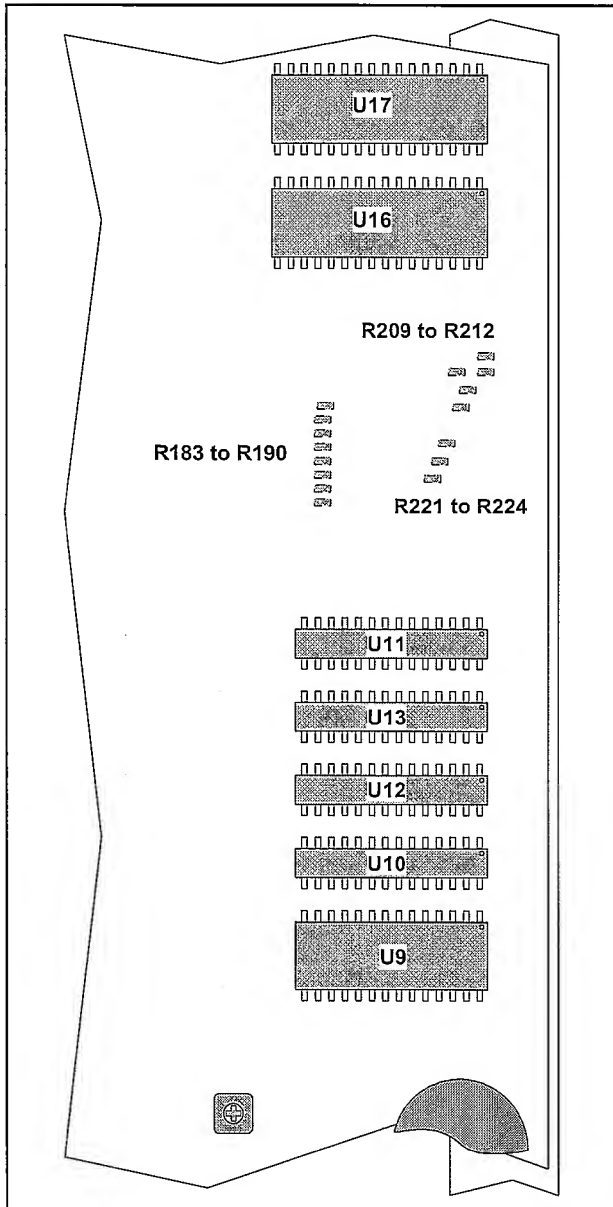


Figure 5-12 Pinning diagram for U9 to U16.

NOTE: By removing R183 to R190, R209 to R212, and R221 to R224 the microcomputer kernel (AD0-AD15) can be separated from the rest of the counter logic.

NOTE: These resistors are located at the bottom side of the PCA.

If you find any fault, continue with traditional troubleshooting techniques and replace defective circuits. See also Chapter 4, Circuit Descriptions, Logical Circuits.

Microcomputer Kernel (Functional Level 4b)

NOTE: It is not possible to run this test before you have run the Keyboard test, Test 5.

- Set the oscilloscope to 2 V/div. on channel A and B.
- Set the time base to 0.5 μ s/div.
- Use pin 40 on U6 to trigger the oscilloscope.
- Run the Address test, Test 6.
- Enter the data code 85 (hex 55) on the DATA ENTRY keypad.
- Press ENTER.
- Enter the address code 43690 (hex AAAA) on the DATA ENTRY keypad.
- Press ENTER.
- Examine the DATA bus lines AD0-AD15 (U6 pin 45-60) with the probe connected to the A-channel, and compare the signal to with Figure 5-13.

The interesting part of the data bus signal is the grayed area on the figure.

- Press LOCAL/PRESET.
- Enter the data code 170 (hex AA) on the DATA ENTRY keypad.
- Press ENTER.
- Enter the address code 43690 (hex AAAA) on the DATA ENTRY keypad.
- Press ENTER.
- Examine the DATA bus lines.
- Press LOCAL/PRESET.
- Enter the data code 170 (hex AA) on the DATA ENTRY keypad.
- Press ENTER.
- Enter the address code 21845 (hex 5555) on the DATA ENTRY keypad.
- Press ENTER.
- Examine the DATA bus lines.
- Press LOCAL/PRESET.
- Enter the data code 85 (hex 55) on the DATA ENTRY keypad.
- Press ENTER.
- Enter the address code 21845 (hex 5555) on the DATA ENTRY keypad.
- Press ENTER.
- Examine the DATA bus lines.
- Press LOCAL/PRESET.

If you find any fault, continue with traditional troubleshooting techniques and replace defective circuits. See also Chapter 4, Circuit Descriptions, Logical Circuits.

CAUTION: Do not enter an address code between E000 and FFFF because this changes the status of the RAM, which has battery backup. This can cause irregular operation of the counter when in normal use.

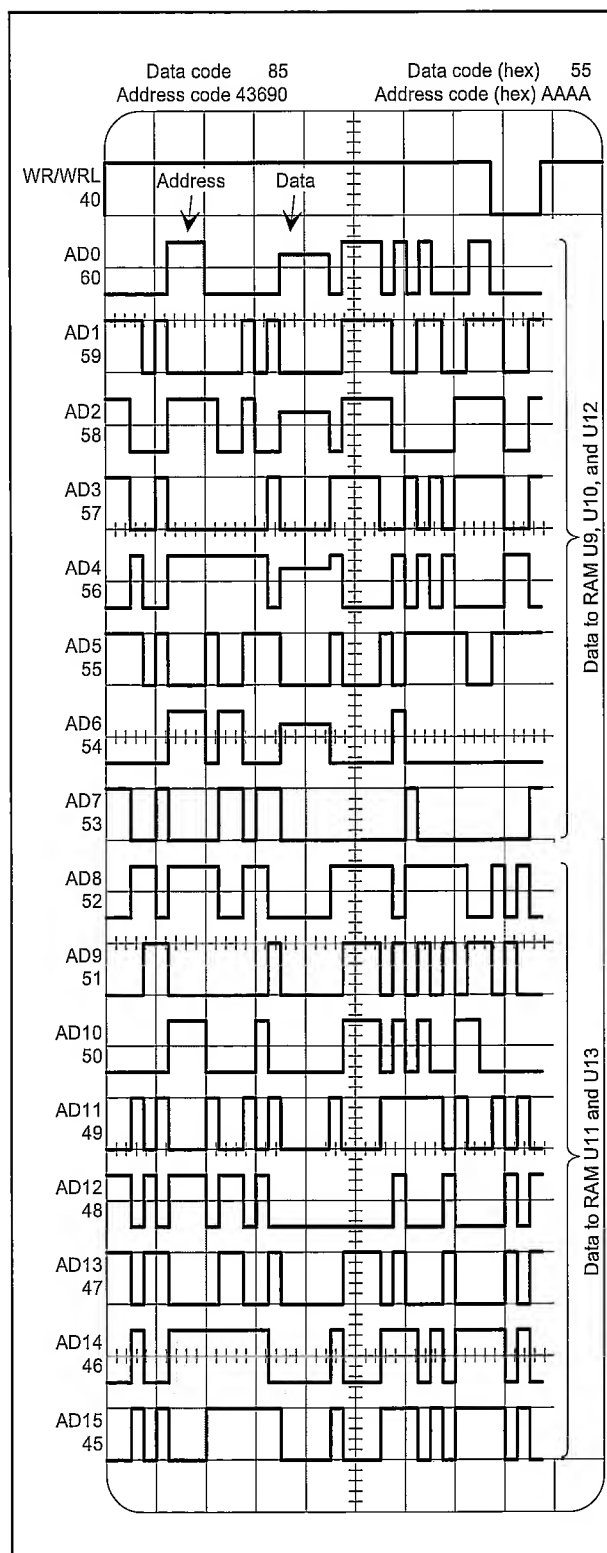


Figure 5-13 Example of AD-bus line diagram.

Internal Control Signals and Display (Functional Level 5a)

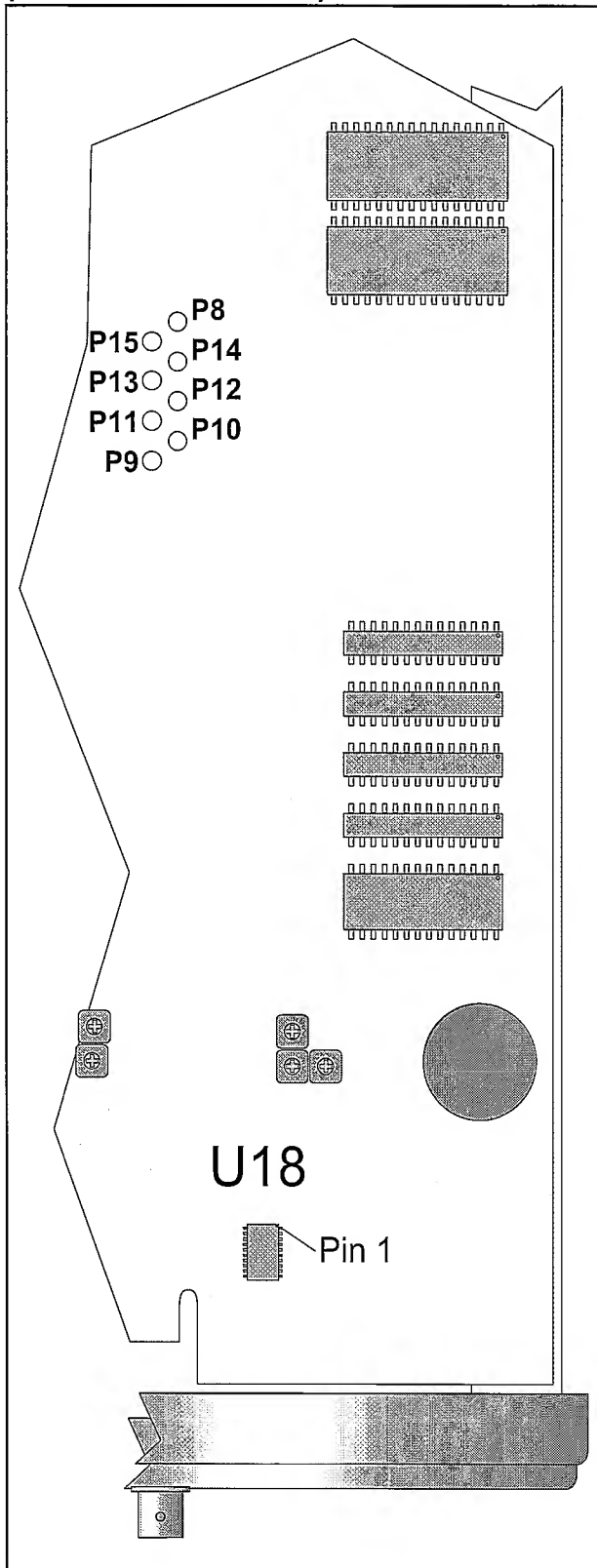


Figure 5-14 Display driving signals and internal control signals can be measured here.

- Run the Control signal test, Test 4.
- Set the oscilloscope to 0.2 V/div and 50 μ s/div.
- Check the output signals of U18, see Figure 5-14. Use test pin P5 to trigger the oscilloscope.

NOTE: U18 is located at the bottom side of the PCA.

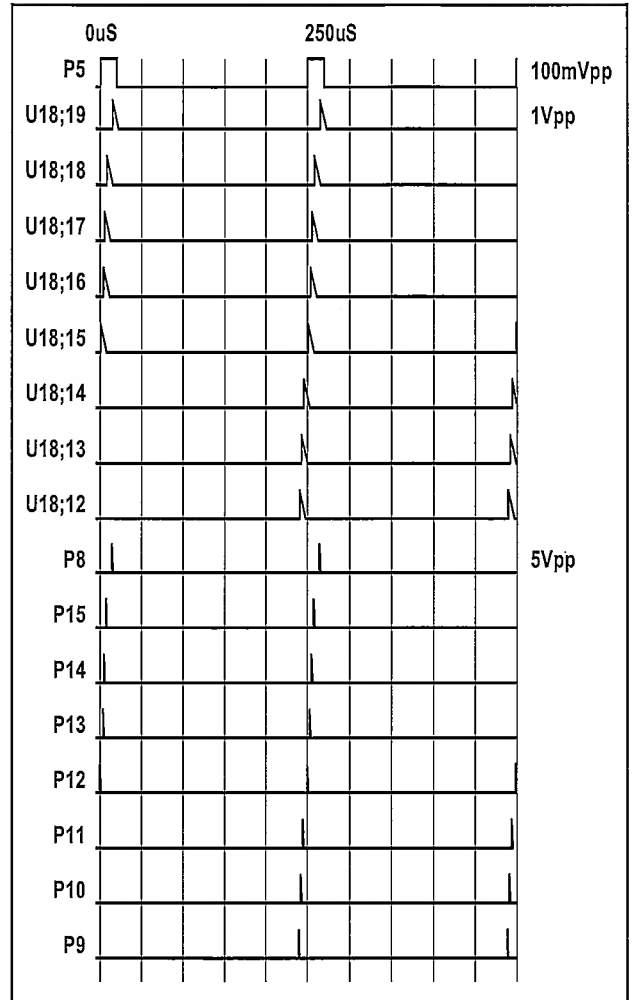


Figure 5-15 Timing diagram for Control signals.

- The timing diagram in Figure 5-15 shows the signals generated by the stimuli program.
- If you find any fault, continue with traditional troubleshooting techniques and replace defective circuits. See also Chapter 4, Circuit Descriptions, Logical Circuits.

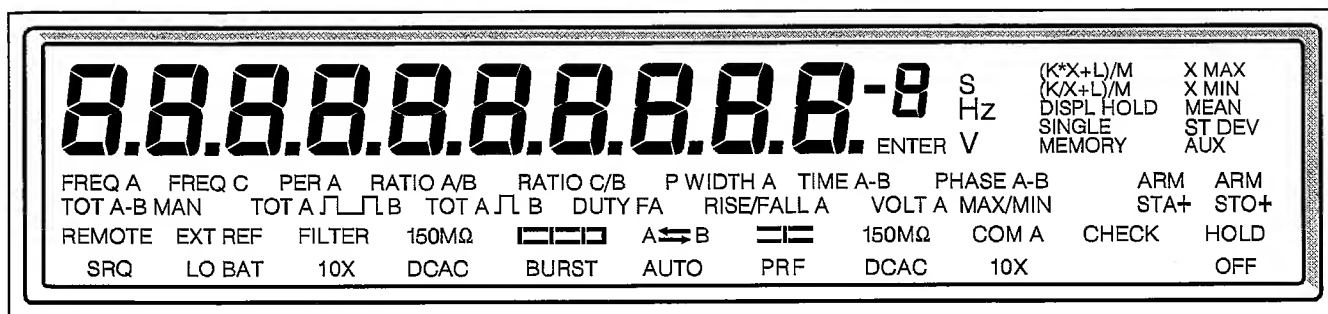


Figure 5-16 Display readout, test 12.

Internal Control Signals and Display (Functional Level 5b)

NOTE: It is not possible to run this test before you have run Keyboard test, Level 6.

- Run DISPLAY test, Test 12.
- Check the validity of the display readout according to Figure 5-16.

Keyboard (Functional Level 6)

- Run the Keyboard test, Test 5.
- Press a pushbutton on the front panel and check that the displayed code are as in the Figure 5-17.

NOTE: The STAND BY/ON and LOCAL/PRESET pushbuttons cannot be tested with this tool.

If you find any fault, continue with traditional troubleshooting techniques and replace defective circuits. See also Chapter 4, Circuit Descriptions, Front Unit, and Keyboard Scanning.

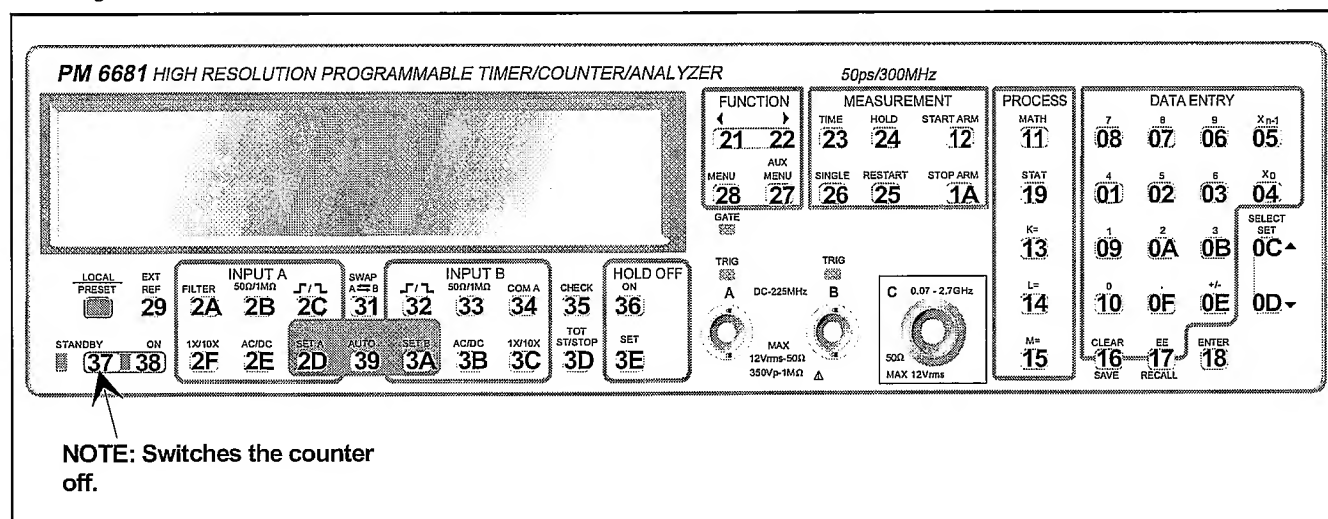


Figure 5-17 Codes for each key, Test 5.

Measuring Logic (Functional Level 7)

• ASIC Stimuli

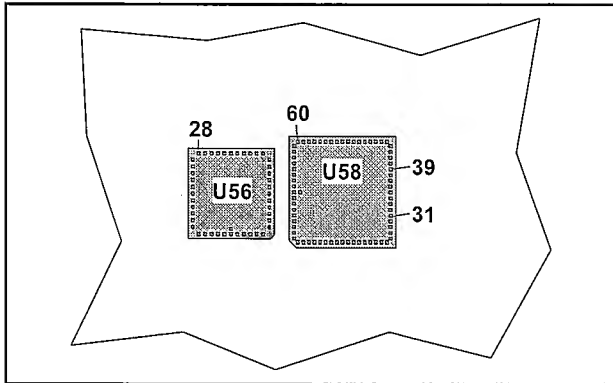


Figure 5-19 Pinning diagram for U56 and U58.

- Run the ASIC tests, Test 7 and 8.

NOTE: Test 6 runs automatically without stimuli signals.

- Set the oscilloscope to 2 V/div and 50 μ s/div.
- Check all signals on U56 and U58. Use P5 to trigger the oscilloscope, see Figure 5-19.

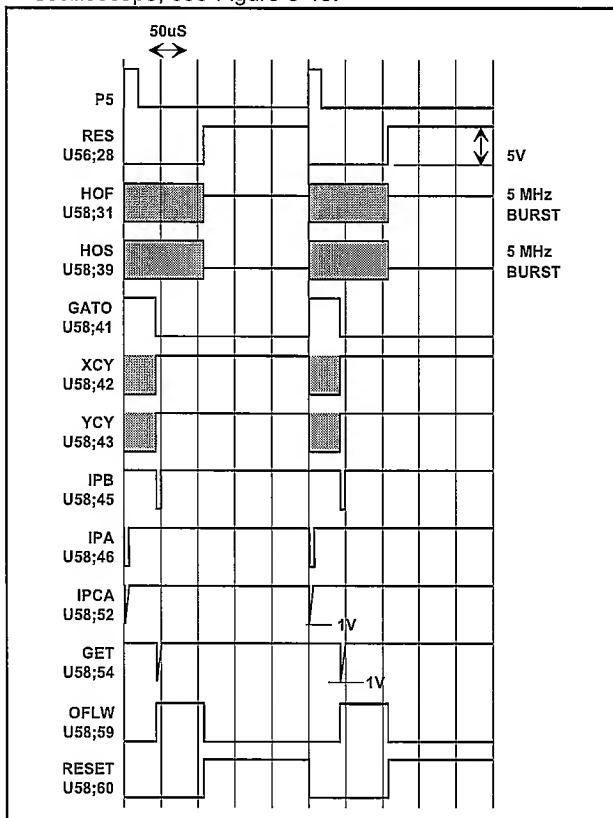


Figure 5-18 Timing diagram for ASIC stimuli test program.

- The timing diagram in Figure 5-18 shows the signals generated by the stimuli program.

If you find any fault, continue with traditional troubleshooting techniques and replace defective circuits. See also Chapter 4, Circuit Descriptions, Counter Circuits.

The following tests should be done with the standard PROM installed in the counter.

- Switch on the counter.
- Connect an arbitrary signal to the EXT ARM input, J5 at the rear panel.
- Trace the signal from J5 to U58 pin 27.
- Connect a 10 MHz signal to the REFERENCE IN input, J6 at the rear panel.
- Trace the signal from J6 to U56 pin 38.
- Select EXT REF.
- Trace the signal from U56 pin 35 to the 10 MHz OUT, J7 at the rear panel.
- Trace the signal from U58 pin 41 to GATE OPEN output, J4 at the rear panel.
- Trace the signal from U58 pin 37 and 38 to J17 pin 30 and 34 at the front panel and to the display and keyboard board.

If you find any fault, replace the defective circuits. See also Chapter 4, Circuit Descriptions, Counter Circuits.

Trigger Level DAC's (Functional Level 8)

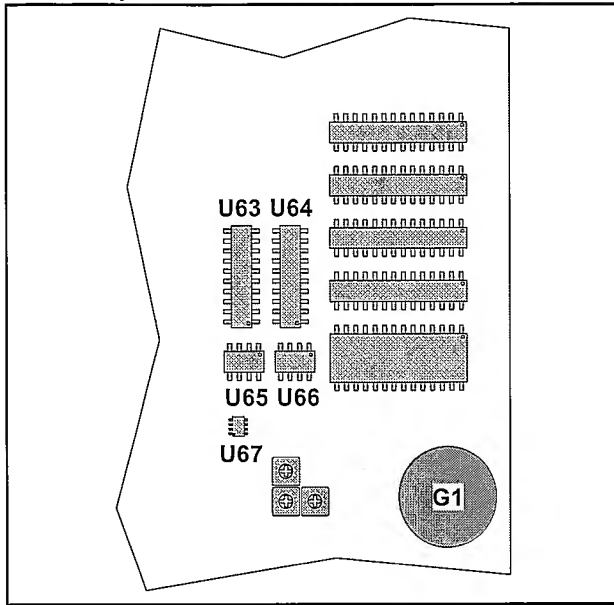


Figure 5-20 Trigger level DACs, U63 and U64.

- Run the DAC test, Test 9.
- Use test pin P5 to trigger the oscilloscope.

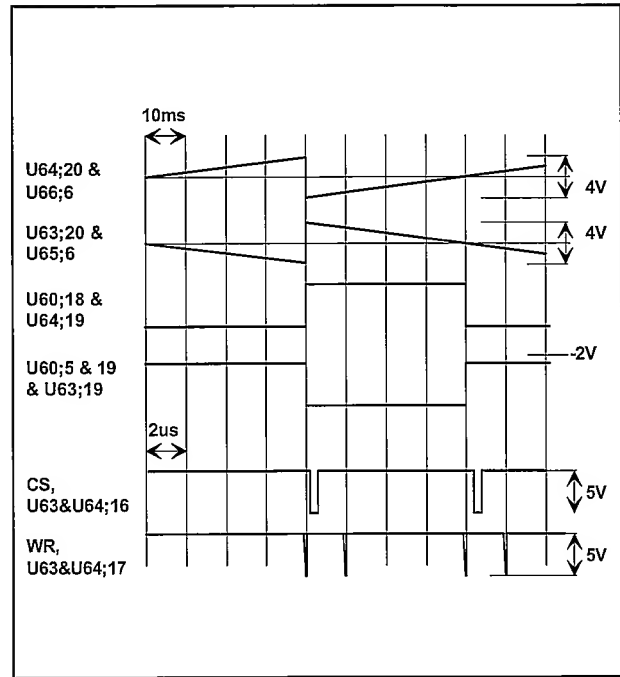


Figure 5-21 Timing diagram for Trigger level DAC's.

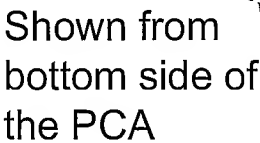
A sawtooth signal of approximately 12.5 Hz is generated on both the A and B trigger levels. The sawtooth spans over the complete trigger level range, and the B value equals the A value multiplied by -1. This means that both signals can be added by using the oscilloscope's ADD TRACE function with the result of approximately zero.

- Check all signals on U63 to U67.

NOTE: U3, and U67 are located at the bottom side of the PCA, see Figure 5-20 and Figure 5-21.

- Trace the signal from U65 and U66 pin 6, to TRIGGER LEVEL A and B OUT, P111 pin 1 and 2 at the rear panel.
- Connect TRIGGER LEVEL A and B OUT to the oscilloscope and check the result by using the ADD TRACE function.

If you find any fault, continue with traditional troubleshooting techniques and replace defective circuits. See also Chapter 4, Circuit Descriptions, Trigger Level Circuits.



Troubleshooting 5-15

Input Amplifier (Functional Level 9)

• A and B Input Check

DC levels

- Switch on the counter.
- Press LOCAL/PRESET and ENTER.
- Select Time A-B.
- Deselect AUTO and set the trigger level to -1 V on both inputs.
- Select ATTENUATION A and B to x1.
- Select DC on both inputs.
- Measure the DC voltages according to Figure 5-22 and Table 5-7. Use the DMM with a 10 k Ω resistor in series with the test cable.

| Test point | V _{DC} | V _{PP} |
|------------|-----------------|-----------------|
| A, a | — | 0.5 |
| B, d | +2.7 | — |
| C, c | -2.7 | — |
| D, d | +0.4 | — |
| E, e | +1.5 | — |
| F, f | +1.5 | — |
| G, g | +0.8 | — |
| H, h | +0 | 0.5 |
| J, j | -0.3 | — |
| K, k | -2.8 | — |
| L, l | -3.8 | — |
| M, m | -1.5 | — |
| N, n | -1.7 | 0.5 (square) |
| O, o | -0.8 | 0.5 (square) |
| P, p | +4.2 | 1 (square) |
| Q, q | -2.2 | 1 (square) |
| R, r | +3.3 | — |
| S, s | -1.6 | — |
| T, t | +4.2 | — |
| U, u | -2.2 | — |
| V, v | 0 | 0.25 |
| W, w | 0 | 0.25 |
| X, x | +2.7 | 0.5 |
| Y, y | +1.2 | — |
| Z, z | +2.6 | 0.5 |

Table 5-7 Typical voltages, Input Amplifier.

AC levels

- Connect a 1000 Hz sine wave signal with an amplitude of 1 V_{p-p} to Input A.
- Set the input amplitude to 1 V_{p-p}.
- Measure the AC-levels according to Figure 5-22 and Table 5-7. Use the oscilloscope and a 10 M Ω probe.
- Trace the signal from V23 pin E and V29 pin E to PROBE COMP VIEW A and B OUT, P25 pin 5 and 4 at the rear panel.

If you find any fault, continue with traditional troubleshooting techniques and replace defective circuits. See also Chapter 4, CIRCUIT DESCRIPTIONS, Input Amplifiers A and B.

• Prescaler 1.3 GHz, PM 9621

In all measurements you should use TP4 as ground.

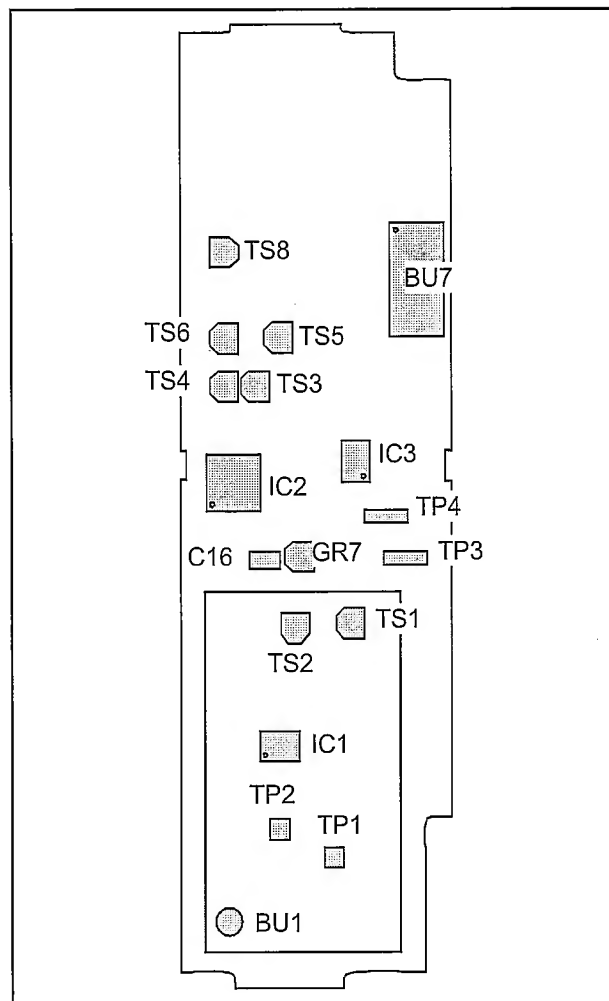


Figure 5-23 Test points, 1.3 GHz prescaler.

Sensitivity Check

- Connect the signal generator to the HF input of the counter.
- Check the "Correct sensitivity and counting" levels according to Figure 5-24 to find out which part may have caused the fault. If everything seems all right, the fault is probably caused by the base unit.

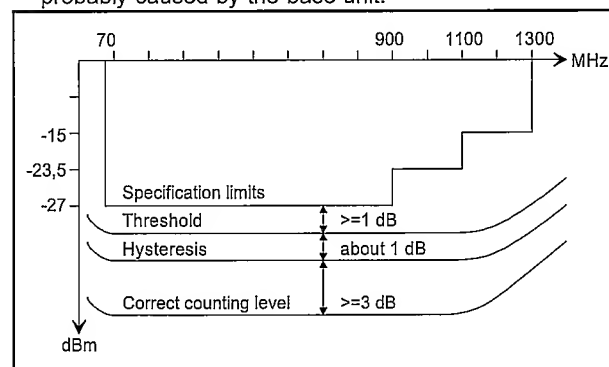


Figure 5-24 Sensitivity and Counting levels.

DC-voltages

- Use a DMM to measure the DC-levels according to Table 5-8.

| Test point | Measured voltage |
|-------------|------------------|
| IC1 pin 1 | ≈ 0.9 V |
| IC1 pin 5 | ≈ 3.1 V |
| TS1 pin b | ≈ 3.1 V |
| TS1 pin c | ≈ 3.1 V |
| TS2 pin e | ≈ 2.3 V |
| IC2 pin 2,3 | ≈ 1.5 V |
| IC2 pin 6,7 | ≈ 4.5 V |
| TS5;c | ≈ 4.5 V |
| TS6;c | ≈ 4.5 V |
| BU7 pin 4 | ≈ 4.7 V |
| TP3 | ≈ 0.57 V |

Table 5-8 DC voltages, PM 9621.

- Connect the signal generator to the HF input of the counter.
 - Set the input frequency to 100 MHz and set the amplitude to -15 dBm, (40 mVRMS).
 - Connect the oscilloscope to BU7 pin 4.
 - Verify that the amplitude is 800 mV p-p and that the period time is 2.56 μ s, (frequency 390 kHz). The DC level should be 3.8 V. If everything seems all right the fault is probably caused by the base unit.
 - Connect the DMM to TP3 and TP4 (GND).
 - Disconnect the input signal.
 - Check that the DC voltage drops ≈ 200 mV.
- If this last measurement is OK, you can skip the Overvoltage Protection Control.

Overvoltage Protection Control

- Connect the signal generator to the HF input of the counter.
- Set the input frequency to 100 MHz, and set the amplitude to 13 dBm, (1 VRMS).
- Check the DC voltages according to 0.

| Test point | Measured voltage | Comment |
|------------|-------------------|--|
| TP1 | -100 \pm 50 mV | Correct |
| TP1 | ≈ +300 mV | GR3 faulty |
| TP1 | ≈ -300 mV | GR4 faulty |
| TP2 | -220 \pm 100 mV | Correct |
| TP2 | ≈ -400 mV | GR11 faulty |
| TP1 & TP2 | ≈ \pm 50 mV | Short circuit in one of GR3, GR4 or GR11 |

Table 5-9 DC voltages, Overvoltage protection control, PM 9621.

- Connect the DMM to IC2 pin 2.
- Check that the DC voltage is ≈ 300 mV.
- Check that the amplitude at IC1 pin 1 is one third of the amplitude at BU1.
- Check that the amplitude at IC1 pin 5 is ≈ 300 mVp-p.
- Check that the amplitude at TS1 collector and TS2 emitter is ≈ 500 mVp-p.

Level Detector Control

- Disconnect the signal generator from the counter.
- Check the level detector according to the table below.
- Connect the signal generator to the HF input of the counter.
- Set the input frequency to 100 MHz and the amplitude to 13 dBm, (1 VRMS).
- Check the level detector according to Table 5-10.

| Test point | Without input signal | With input signal |
|--------------|----------------------|-------------------|
| GR7, C16 | ≈ 320 mV | ≈ 10 mV |
| IC3 pin 3 | ≈ 570 mV | ≈ 370 mV |
| IC3 pin 1, 6 | ≈ 2.2 V | < 0.1 V |
| IC3 pin 5 | ≈ 2.07 V | ≈ 2.1 V |
| IC3 pin 7 | < 0.8 V | ≈ 4.4 V |
| TS8;b | ≈ 4.9 V | ≈ 4.2 V |
| BU7 pin 4 | ≈ 4.7 V | ≈ 3.8 V |

Table 5-10 DC voltages, Level detector, PM 9621.

Divider and Differential Stage Control

- Connect the oscilloscope to IC2 pins 6 and 7.
- Check that the amplitude is 800 mVp-p and that the period time is 2.56 μ s, (frequency 390 kHz). The DC level is 4.5 V.
- Connect the oscilloscope to TS3;b and TS4;b.
- Check that the amplitude is 800 mVp-p and that the period time is 2.56 μ s, (frequency 390 kHz). The DC level is 3.8 V.
- Connect the oscilloscope to TS5;c and TS6;c.
- Check that the amplitude is 800 mVp-p and that the period time is 2.56 μ s, (frequency 390 kHz). The DC level is 4.5 V.

Signal Measurement

- Connect the signal generator to the HF input of the counter.
- Connect the Y-input of the oscilloscope to TP3 and TP4 (GND).
- Connect the X-input of the oscilloscope to the horizontal output of the generator.
- Set the frequency range of the generator to 70-1300 MHz.
- Set the amplitude to -15 dBm, (40 mVRMS).
- Figure 5-25 shows the typical frequency curve of the prescaler.

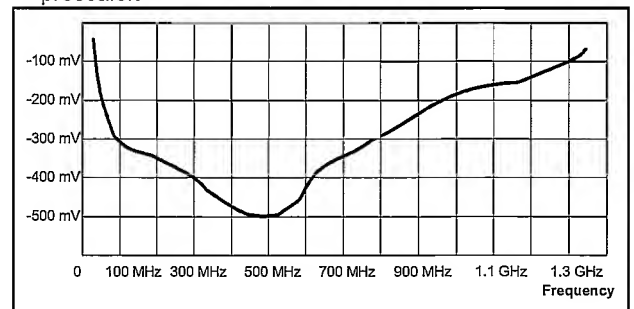


Figure 5-25 Typical Frequency Curve PM9621.

• Prescaler 2.7 GHz, PM 9624

See Chapter 2, Performance Check, for verification.

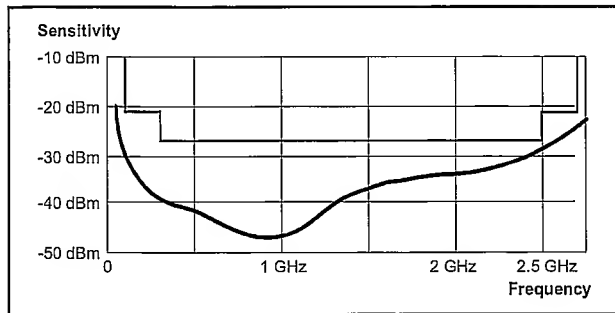


Figure 5-26 Specified and typical sensitivity of input C with option PM 9624.

This prescaler cannot be repaired in a local workshop. It must be sent to a Fluke Service Center, who will transfer the prescaler to the factory for repair.

• Prescaler 4.2 GHz, PM 9625B

See Chapter 2, Performance Check, for verification.

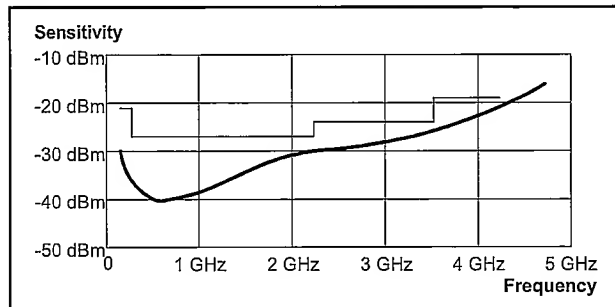


Figure 5-27 Specified and typical sensitivity of input C with option PM 9625B.

This prescaler cannot be repaired in a local workshop. It must be sent to a Fluke Service Center, who will transfer the prescaler to the factory for repair.

• Prescaler 4.5 GHz, PM 9625

See Chapter 2, Performance Check, for verification.

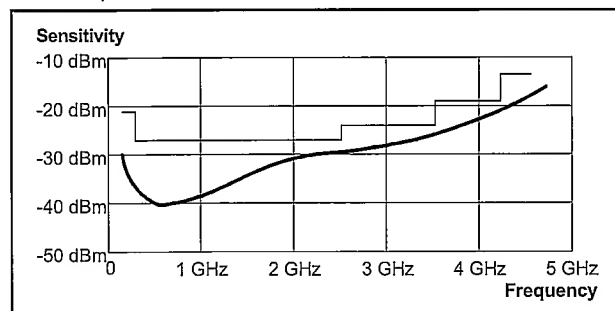


Figure 5-29 Specified and typical sensitivity of input C with option PM 9625.

This prescaler cannot be repaired in a local workshop. It must be sent to a Fluke Service Center, who will transfer the prescaler to the factory for repair.

GPIB interface and Analog output (Functional Level 10)

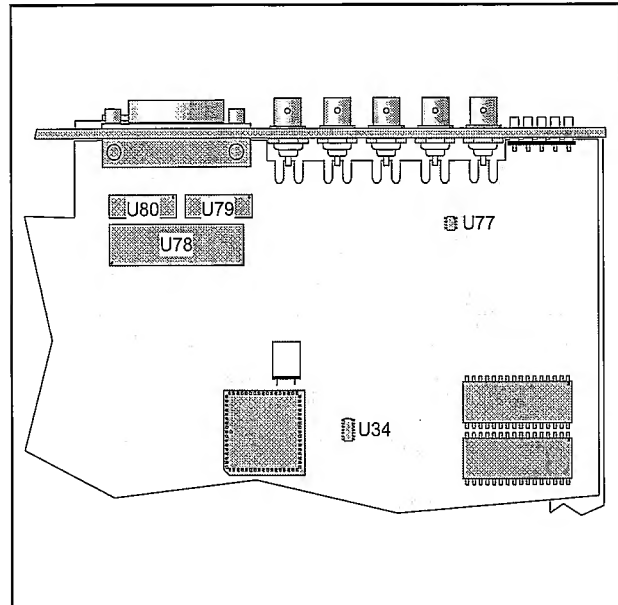


Figure 5-28 Component layout, GPIB interface.

- Set the oscilloscope to 2 V/div and 10 ms/div.
- Run the Analog out 1 test, Test 10.

The μ -controller generates a pulse width modulated signal with a variable duty cycle. This PWW signal is converted by U34 to a sawtooth signal of approximately 20 Hz. U77 makes a DC voltage in the range 0 to 4.98 V of the sawtooth and feeds it to the analog output on the GPIB interface.

NOTE: U34, and U77 are located at the bottom side of the main PCA.

Trace the signal from U6 pin 39 on the main board to ANALOG OUT, J3 at the rear panel.

- Use P5 on the main board to trigger the oscilloscope.
- Run the ANALOG OUT 2 test, Test 11.
- The analog output now outputs a DC voltage that can be controlled by pressing the UP/DOWN keys.

0 = min value = 0 V

255 = max value = 4.98 V

- Connect an IBM PC or compatible, equipped with a PM 2201, GPIB interface or equivalent and its software, to the interface in the counter.

- Insert the floppy disc labeled: Test and Calibration program for PM 6681. This test program is included in this Service manual.

- Change to the drive where the test floppy is inserted.

- Type GPIBTEST and press enter to start to program.

All instructions needed to run the program are supplied by the program itself.

NOTE: This test program does not test the analog output.

If you find any fault, continue with traditional troubleshooting techniques and replace defective circuits. See also Chapter 4, Circuit Descriptions, GPIB-Interface.

Safety Inspection and Test After Repair

General Directives

After repair in the primary circuits, make sure that you have not reduced the creepage distances and clearances.

Before soldering, component pins must be bent on the solder side of the board. Replace insulating guards and plates.

Safety Components

Components in the primary circuits are important to the safety of the instrument and may only be replaced by components obtained from your local Fluke organization.

Check the Protective Ground Connection

Visually check the correct connection and condition and measure the resistance between the protective lead at the plug and the cabinet. The resistance must not be more than 0.5 Ω . During measurement, the power cord should be moved. Any variations in resistance shows a defect.

Chapter 6

Calibration Adjustments

Introduction

Required Test Equipment

| Type | Performance | Model No |
|-------------------------------------|--------------------|------------------------------|
| DMM | 5 full digits | PM 2534 |
| Counter | | PM 6669 |
| DC source | 5 V | Philips PE 1536 |
| LF-synthesizer | 10 kHz/20 Vpp | PM 5193 S |
| PC incl. CRC GPIB interface | | ** |
| Interpolator Calibration program | | ** (incl. in this manual) |
| Pulse Generator | 125 MHz/2ns | PM 5786 (PM 5781**) |
| Signal generator | 1300 MHz | 6062A |
| Sampling oscilloscope | | |
| FET probe | | |
| Passive probe | 10:1 <1.5 pF | PM 8926 |
| Terminator | 50 Ω /1 W | PM9585 or Y9103 |
| Attenuator | 20 dB | PM 9591 or Y9102 |
| Power splitter | 50 Ω /4W | PM 9584 |
| T-piece | | PM 9067; Y9107 |
| 10 MHz reference | 1×10^{-7} | PM 9691 |
| 10 MHz reference | 1×10^{-9} | PM 6681R or PM6685R* |
| BNC-BNC cables | | |
| Insulated screwdriver | | |

Table 6-1 Required Test Equipment.

* For adjustment of Oven Oscillators only.

** PM 5781 required for Interpolator calibration adjustment.

Preparation

WARNING: Live parts and accessible terminals which can be dangerous to life are always exposed inside the unit when it is connected to the line power. Use extreme caution when handling, testing, or adjusting the counter.

Before beginning the calibration adjustments, power up the instrument and leave it on for at least 60 minutes to let it reach normal operating temperature.

Power Supply

CAUTION: If you adjust the +5V trimmer you have to adjust the complete instrument.

• Setup

- Connect the counter to the line power.
- Switch on the counter.
- Press PRESET, then press ENTER.

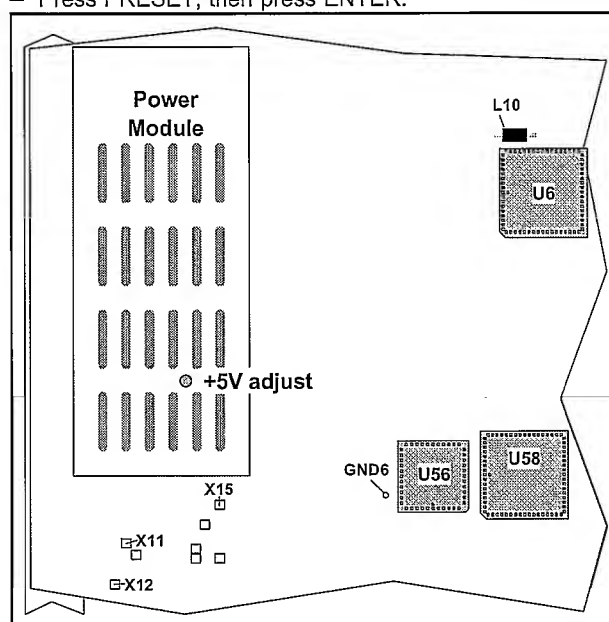


Figure 6-1 Test points and trimmer for the Power Supply.

• Adjustment

- Connect the DMM to test points L10 and GND6, see Figure 6-1.
- Adjust the +5V trim potentiometer R446=+5V adjust in the power supply using an insulated screwdriver, until the DMM reads $+5.000 \pm 0.001$ V.
- Check that the voltage at the test points X15=+5 and GND6 is $+5.00 \pm 0.05$ V.
- Check that the unregulated voltage from the power supply at test points X11=+15 and GND6 is about +18 V.
- Check that the unregulated voltage from the power supply at test points X12=-9 and GND6 is about -8 V.

Crystal Oscillators

16 MHz Oscillator

- Connect the counter via a probe to the test point P7 and GND5.
- Check that the measured frequency is 8 MHz \pm 100 Hz.

External Reference Input Multiplier

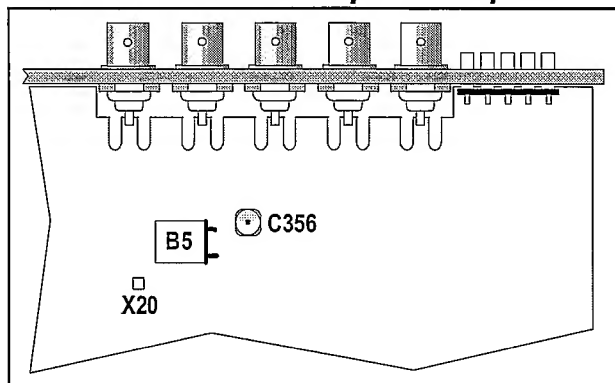


Figure 6-2 Trimmers for the 10 MHz Frequency Multiplier.

• Setup

| | | |
|-----------------------|------------|----------------------------|
| PM 6681 | Function | EXT REF |
| LF synthesizer | Amplitude | 1 V Sinus |
| | Frequency | 1 MHz |
| Sampling Oscilloscope | Time | 200 μ s/div. |
| | Setting: A | 1 V/div., 50 Ω , DC |

Table 6-2 10 MHz Multiplier setup.

- Connect the LF synthesizer to the REFERENCE INput at the rear of the PM 6681 via a 50 Ω attenuator.
- Connect the Sampling Oscilloscope to the test point X20. (Use a FET probe).
- Adjust C356 to maximum amplitude. See Figure 6-2.

Standard Oscillator

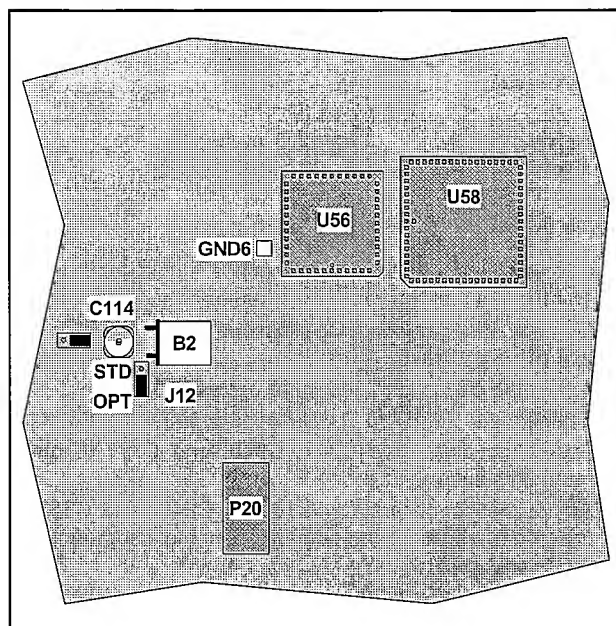


Figure 6-3 Trimmers for the reference oscillator frequency.

• Setup

- Connect the counter to the 10 MHz OUTput at the rear of the PM 6681.

The adjustment should preferably be made at an ambient temperature of +25°C.

• Adjustment

- Adjust C114=STD OSC ADJ until the counter reads 10 MHz +2 Hz. See Figure 6-3.

100 MHz Frequency Multiplier

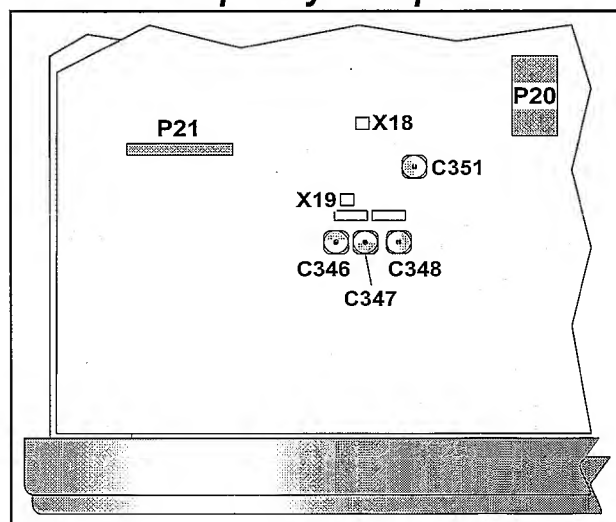


Figure 6-4 Trimmers for the 100 MHz Frequency Multiplier.

• Setup

| | | |
|-----------------------|------------|----------------------------|
| PM 6681 | Function | EXT REF |
| LF synthesizer | Amplitude | 1 V Sinus |
| | Frequency | 10 MHz |
| Sampling Oscilloscope | Time | 200 μ s/div. |
| | Setting: A | 1 V/div., 50 Ω , DC |

Table 6-3 100 MHz Multiplier setup.

- Connect the Sampling Oscilloscopes trigger input to the 10 MHz OUT at the rear of the counter.
 - Connect the Sampling Oscilloscope via a probe to the test point X19. See Figure 6-4.
 - Adjust the capacitor C346 to 10 cycles/100 ns.
 - Connect the Sampling Oscilloscope to the test point X18.
 - Adjust the capacitors C347, C348, and C351 to maximum amplitude.
 - Adjust the capacitors C346, C347, C348, and C351 to maximum amplitude in sequence until maximum amplitude is reached at X18.
 - Connect the LF-synthesizer with a 10 MHz reference to the EXT-REF input of the counter.
 - Select EXT REF.
 - Change the input frequency ± 1 kHz.
- If the amplitude is varying with the frequency the capacitors C347 and C348 has to be adjusted again. Begin to adjust the the amplitude at 10 MHz +1 kHz.
- Eventuality C346 has to adjusted as well.

Optional TCXO, PM 9678B

• Setup

- Connect the counter to the line power.
- Switch on the counter.
- Press PRESET, then press ENTER.
- Connect the 10 MHz reference to the A input of the counter.

The adjustment should preferably be made at an ambient temperature of +23°C.

• Adjustment

- Adjust the trim capacitor C1 on the optional oscillator until the counter reads 10 MHz ± 1 Hz. See Figure 6-5.

Optional Oven Oscillators, PM 9690 and PM 9691

• Setup

- Connect the counter to the line power.
- Switch on the counter.
- Press PRESET, then press ENTER.

| | | |
|--------------|------|------------|
| Oscilloscope | Time | 100ns/div. |
|--------------|------|------------|

Table 6-4 Optional oscillator setup.

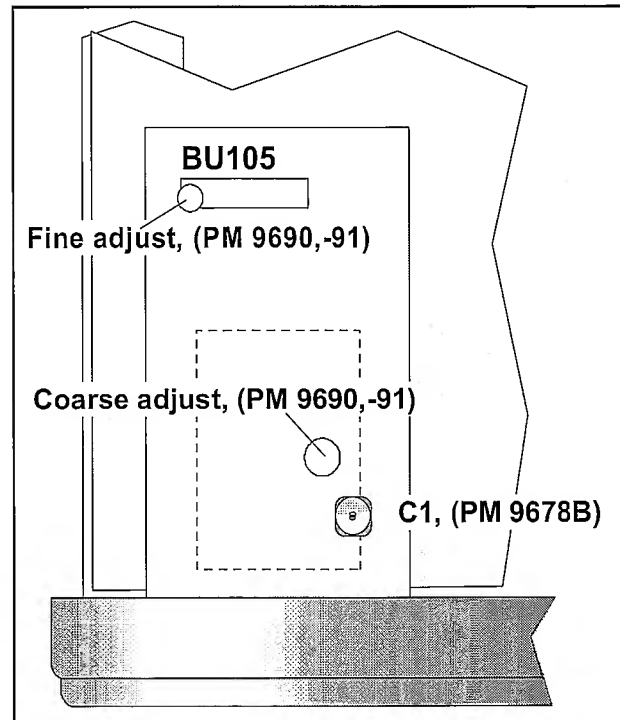


Figure 6-5 Trimmers for the optional oscillator frequency.

The adjustment should preferably be made at an ambient temperature of +23°C.

The oscillator must have been operating continuously for 48 hours before any adjustment is made.

- Connect the 10 MHz reference signal of the PM 668XR to EXT TRIG of the oscilloscope.
- Connect the 10 MHz out of the counter to the A-input of the oscilloscope.

• Adjustment

- Adjust the FINE trimmer on the oscillator until the waveform moves with a velocity of a maximum of 1 div/10s (0.1 Hz). See Figure 6-5.

If the adjustment is too narrow, proceed as follows:

- Set the FINE trimmer fully clockwise.
- Remove the two screws holding the oscillators text plate.
- Use a pair of tweezers to remove the small plastic cylinder beneath the text plate.
- Connect an external counter to the 10 MHz OUT socket of the counter to be adjusted.
- Adjust the COURSE trimmer until the display reads 10000003 Hz on the external counter.
- Adjust the FINE trimmer until the display reads 10000000 Hz on the external counter.
- Reinstall the plastic cylinder and the text plate to the oscillator.

Adjust the FINE trimmer on the oscillator until the waveform moves with a velocity of a maximum of 1 div/10s (0.1 Hz).

Interpolator

NOTE: This adjustment has only to be performed if the timer/counter has lost its calibration information, (that is if the counter displays ZCaL . LOSTZ, or if you have made any repairs in the interpolator circuits.

• Setup

- Connect the Pulse Generators output A to the input A of PM 6681.
- Connect the LF-synthesizers to the EXT INput of the Pulse Generator.
- Connect a 10 MHz (aging at least 10^{-8}) reference to the reference input of PM 6681 and the synthesizer.
- Connect the the GPIB connectors of the PM 6681, LF-synthesizer, and Pulse Generator to the PC;s GPIB card.

NOTE: The timer/counter, synthesizer, and the pulse generator should not have the same GPIB address, none of them should have address 0 or 30, (this is used by the PC).

• Adjustment

- Turn on the *timer/counter*, the synthesizer, and the pulse generator.

If the *timer/counter* shows a flashing ZCaL . LOSTZ, press the preset button until this message disappears.

NOTE: The calibration should be done when the counter has been on for more than 20 minutes. If you start the calibration program before 20 minutes has passed since power on, the program will wait the required time.

- Insert the discette labeled "Test and Calibration program for PM 6681", into the $3\frac{1}{2}$ " disc-drive on the PC.
- Start the calibration program from the DOS command prompt with the command "[path]CALVER81". Supposing you use the A: drive, this might look like:

C:\>a:CALVER81

The first displayed screen on the PC will show you the needed hardware and software to run the calibration program. It also shows the bus addresses the different instrument must be set to.

- Press ENTER when you are ready to begin the calibration.
- Now you shall enter the different GPIB addresses for the instruments involved.
- Type the serial number of the counter under test and press ENTER.

Now you will be asked if you want to calibrate the counter. The calibration will take between 20 and 60 minutes to complete. (If you answer no (n) on this question you will be asked if you want to verify the calibration of the interpolators. The verification will only take a few minutes.)

The program will attempt calibration using a number of different input signals, and will check the result, choosing for the final calibration the best result achieved.

After the calibration is completed the best calibration parameter will be stored in the counters battery backedup RAM. A printout of the calibration result will also be sent to LPT1 of the PC. The printout will look as shown below:

NOTE: Even though the specification says 50ps the system does not accept more than 40ps. This limit is set to ensure that the spec should be fulfilled over the whole temperature range.

```
*****
* PM6681 TEST DATA                                TEST PROGRAM VERSION 1.0      *
*****
* DATE: 94-06-14      TIME: 12:51:25                *
* IDENTITY CODE: SM 999                                *
* TASK: VERIFICATION OF INTERPOLATOR CALIBRATION      *
*****
* Identification Query:                                *
* PHILIPS, PM6681, 0, MAIN X1.02  Mar 08 1994 13:53:01 / GPIB X1.13  Mar 0 *
* PM9626,0                                              *
*****
* T (°C) CAL PLS (s) MIN SDEV MEAN SDEV MEAN SPEC  MAX SDEV  MAX SPEC P/F *
*****
* +22    4.29E-009 2.16E-011 2.91E-011 3.00E-011 3.99E-011 4.00E-011  P
*****
|-----|-----|-----|-----|-----|-----|-----|
| Calibrated at | Pulse used | Minimum value | Mean value  | Mean value  | Maximum value | Maximum    | Pass/
| temperature   | to calibrate| measured by   | measured by | accepted by | measured by   | value accepted | Fail
|               |             | the system    | the system  | the system  | the system    | by the system  |
```

All of these values are results of standard deviation measurements of pulse widths in the range 4 to 50 ns (in 2 ns steps). For each pulse width 2000 samples are taken.

Input Amplifier

• Setup

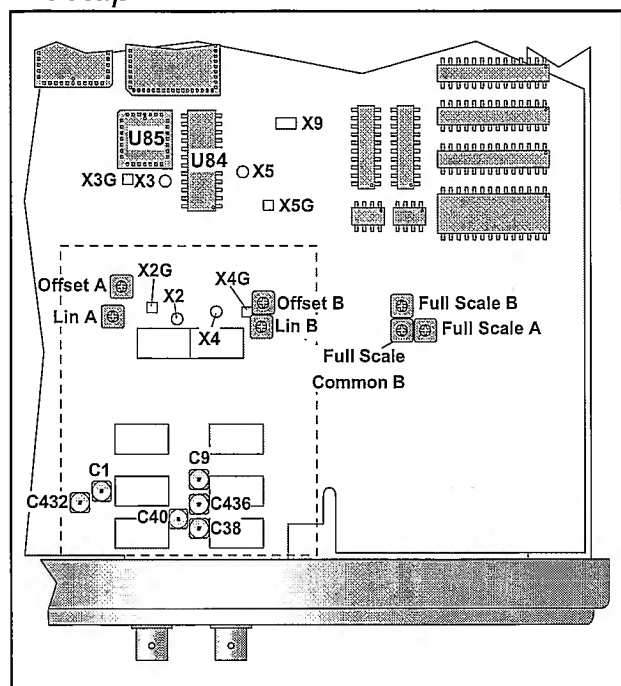


Figure 6-7 Test points and trimmers for the Input amplifiers.

Step Response

• Setup

| | | |
|-----------------------|--------------|--|
| PM 6681 | Function | TIME A-B |
| | Input A+B | 50 Ω /DC/Manual trigger levels |
| | Attenuation | X1 |
| Pulse Generator | Amplitude | 4 V |
| | Pulse Period | 1 ms |
| Sampling Oscilloscope | Time | 100 μ s/div. |
| | Setting: A | 10 mV/div. (10:1 <1.5 pF passive probe),DC |

Table 6-5 Step Answer setup.

NOTE: The adjustment must be made at an ambient temperature of +25°C.

- Connect the Pulse Generator to the A input of the counter (B input) via the T-piece.

NOTE: It is of most importance that the output pulses from the pulse generator does not tilt more that 0.1% of the pulse amplitude.

- Connect the channel A of the oscilloscope via a probe to the other output from the T-piece, see Figure 6-6.
- Adjust the amplitude of the oscilloscope until the pulse is 8 divisions high.
- Adjust the probe until the pulse is absolutely flat.

• Adjustment

Channel A

- Connect the probe to test point X2.
- Adjust R167=LIN A and C40=1X A until the signal is absolutely flat.

Channel B

- Connect the probe to test point X4.
- Adjust R168=LIN B and C38=1X B until the signal is absolutely flat.

• Setup

| | | |
|-----------------------|----------------|---|
| PM 6681 | Function | VOLT A MAX/MIN |
| | Input A+B | 50 Ω /DC/Manual trigger level |
| | Measuring time | 80 ns |
| | Attenuation | 1X |
| Sampling Oscilloscope | Amplitude | 10 mV/div on channel B (10:1 <1.5 pF passive probe) |
| | Time | 5 μ s/div |
| | | |
| Pulse Generator | Amplitude | 4.8 V |
| | Pulse Period | 100 μ s |
| | Rise/Fall time | 3 ns |
| | Pulse shape | Symmetrical/positive pulse |

Table 6-6 10X Attenuator setup.

- Press AUX MENU.
- Select Auto Lo. and press ENTER.
- Type 1000 on the numeric keypad and press ENTER.
- Connect CLOCK OUT from the pulse generator to TRIGG IN on the oscilloscope.
- Connect the Pulse generator to the A input via a T-piece.
- Connect the oscilloscope to the other end of the T-piece and check that the base- and top line of the pulse is absolutely flat.

• Fine adjustment

At the first hand the X1 attenuation should be best adjusted.

NOTE: It is of most importance that the screwdriver does not contain any kind of magnetic material.

1X Attenuator channel A

NOTE: Four digits on the display.

- Connect the probe to test point X2. For trimmers and test points see Figure 6-6.
- Adjust C40=1X A until the tilt of the top line is 0.3 V. See Figure 6-7.

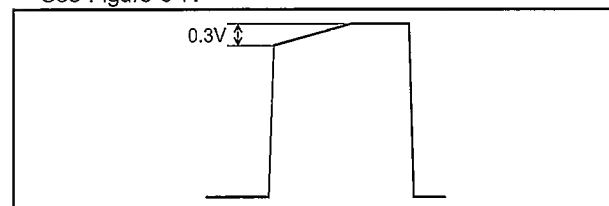


Figure 6-6 The tilt of the top line is 0.3 V.

- Remove the probe.
- Read the counters display.
- Adjust C40=1X A until the displayed value has increased 5 to 10 mV.

10X Attenuator channel A

NOTE: Three digits on the display.

- Select 10X on input A.
- Connect the probe to test point X2. For trimmers and testpoints see Figure 6-6.
- Adjust C1=10X A and C432 until best possible pulse, without any overshoots or undershoots.
- Adjust C1=10X A until the tilt of the top line is 0.3 V. See Figure 6-7.
- Remove the probe.
- Read the counters display.
- Adjust C40=10X A until the displayed value has increased 10 to 30 mV.
- Shift between 1X and 10X and check that the displayed value does not differ more than ± 50 mV.

1X Attenuator channel B

NOTE: Four digits on the display.

- Connect the probe to test point X4. For trimmers and testpoints see Figure 6-6.
- Adjust C38=1X B until the tilt of the top line is 0.3 V. See Figure 6-7.
- Remove the probe.
- Read the counters display.
- Adjust C38=1X B until the displayed value has increased 5 to 10 mV.

10X Attenuator channel B

NOTE: Three digits on the display.

- Select 10X on input B.
- Connect the probe to test point X4. For trimmers and testpoints see Figure 6-6.
- Adjust C9=10X B and C436 until best possible pulse, without any overshoots or undershoots.
- Adjust C9=10X B until the tilt of the top line is 0.3 V. See Figure 6-7.
- Remove the probe.
- Read the counters display.
- Adjust C38=10X B until the displayed value has increased 10 to 30 mV.
- Shift between 1X and 10X and check that the displayed value does not differ more than ± 50 mV.

Sensitivity

• Setup

| | | |
|----------------|----------------|---------------------------------------|
| PM 6681 | Function | DUTY F A |
| | Input A+B | 50 Ω /AC/Manual trigger levels |
| | Attenuation | 1X |
| | Trigger levels | 0 V |
| | Measuring time | 100 ms |
| LF synthesizer | Frequency | 1 kHz Sinus or triangle |
| | Amplitud | 500 mV pp before the attenuator |
| Oscilloscope | Amplitude | 50 mV/div (10:1 probe) |
| | Time | 200 μ s/div |

Table 6-7 Sensitivity setup.

- Connect the LF synthesizer via an 20dB attenuator to input A.
- Check with the oscilloscope that the signal at the input of the counter is clean and real sinus or triangle.
- Adjust the resistor R18=OFFSET A until the counter shows 0.500 ± 0.001 .
- Connect the LF synthesizer via the 20dB attenuator to input B.
- Press SWAP.
- Adjust the resistor R44=OFFSET B until the counter shows 0.500 ± 0.001 .

Trigger Levels

• Setup

| | | |
|-----------|----------------|---------------------------------------|
| PM 6681 | Function | FREQ A |
| | Input A+B | 1M Ω /DC/Manual trigger levels |
| | Attenuation | 1X |
| | Trigger levels | 5 V |
| | Measuring time | 80 ns |
| DC source | Amplitude | 5.0 V ± 50 mV. |

Table 6-8 Trigger Levels setup.

• Adjustment

• Channel A

- Connect a stable DC voltage to the A input of the counter via a T-piece. See Figure 6-8.
- Connect a DMM to the other end of the T-piece.

NOTE: Use coaxial cables to avoid signal interference.

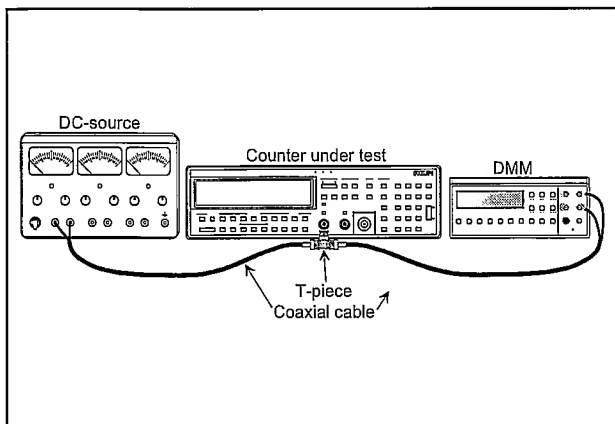


Figure 6-9 Connect a stable DC voltage to the A input of the counter.

- Press AUX MENU.
- Select **AU.CODES** and press ENTER.
- Type 23.1 on the numeric keypad and press ENTER.
- Set the measuring time to 80 ns.
- Press STAT and select MEAN.
- Type 10 on the numeric keypad and press ENTER.
- Select 1X attenuation.

NOTE: If it is not possible to select 1X attenuation R308 has to be adjusted.

- Adjust R308=FULL SCALE A until the counter displays the same value as the DMM ± 1 mV.

• Common

- Select COMMON.
- Press SWAP.
- Adjust R311=FULL SCALE COMMON B until the counter displays the same value as the DMM ± 1 mV.

• Channel B

- Move the the DC source and the DMM to the B input.
- Deselect COMMON and SWAP.
- Adjust R331=FULL SCALE B until the counter displays the same value as the DMM ± 1 mV.

Analog output

• Setup

| | | |
|----------------|-------------|---------------------------------------|
| PM 6681 | Input A | 50 Ω /AC/Manual trigger levels |
| | Attenuation | X1 |
| LF synthesizer | Amplitude | 1 Vpp* |
| | Frequency | 1000.01 Hz square wave |

Table 6-9 GPIB interface setup.

* The output amplitude mentioned is the set amplitude; it is only valid for an open output of the synthesizer.

• Adjustment

- Connect the DMM to the BNC connector ANALOG OUT-put at the rear of the PM 6681.
- Activate the analog output.
 - Select AUX MENU.
 - Press SELECT/SET until the display reads ANALOG OUT.
 - Press ENTER.
 - Press SELECT/SET to select ON.
 - Press ENTER.
 - Type 0.001 ENTER via the keyboard.
- Connect the LF synthesizer to the A input of the counter. The counter should read 1000.0xxxxx Hz.
- Adjust the trimmer ZERO=R384 (see Figure 6-9) until the output voltage is 0 V ± 1 mV.

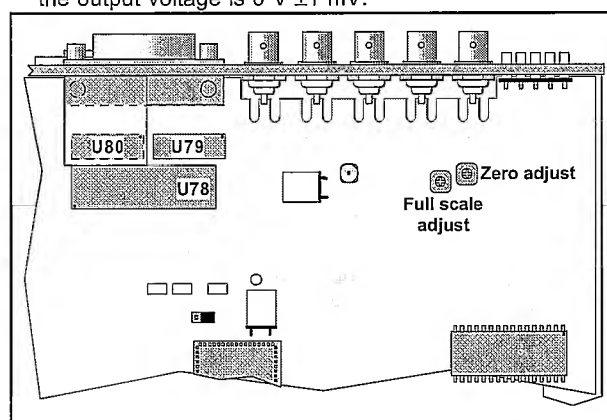


Figure 6-8 Trimmers for the Analog output.

- Set the LF synthesizer to 999.90 Hz/1 Vpp square wave. The counter should read 999.9xxxxx Hz.
- Adjust the trimmer FULL SCALE=R381 (see Figure 6-9) until the output voltage is 4.980 V ± 3 mV.
- Set the LF synthesizer to 100.0 Hz/1 Vpp square wave. The counter should read 100.0xxxxxx Hz.
- Check that the output voltage is 500 mV ± 5 mV.

1.3 GHz HF-input, PM 9621

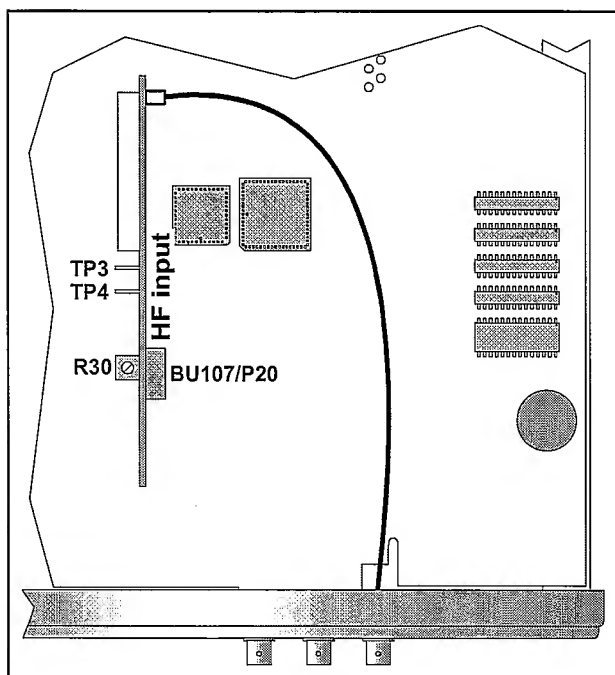


Figure 6-11 Test points and trimmers for the 1.3 GHz HF-input.

NOTE: Before beginning any adjustments, the HF input must have been in operation for at least one minute, to let it reach normal operating temperature.

• Setup

- Connect the counter to the line power.
- Switch on the counter.
- Press PRESET, then press ENTER.

| PM 6681 | Input C | FREQ C |
|------------------|-----------|----------------------|
| Signal generator | Frequency | 900 \pm 25 MHz |
| | Amplitude | 7.5 \pm 0.5 mV RMS |

Table 6-10 1.3 GHz HF-input setup.

- Connect the signal generator to the HF-input.

• Adjustment

- Turn the potentiometer R30 fully counterclockwise. See Figure 6-10.
- Check that the GATE indicator stops blinking.
- Turn R30 slowly clockwise until the GATE indicator starts blinking.

The input frequency, 900 \pm 25 MHz will now be displayed.

2.7 GHz HF-input, PM 9624

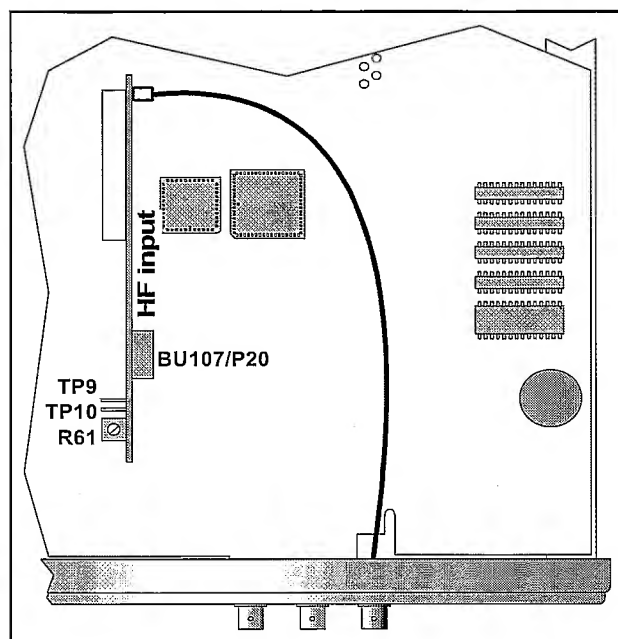


Figure 6-10 Test points and trimmers for the 2.7 GHz HF-input.

NOTE: Before beginning any adjustments, the HF input must have been in operation for at least one minute, to let it reach normal operating temperature.

• Setup

- Connect the counter to the line power.
- Switch on the counter.
- Press PRESET, then press ENTER.
- Connect the signal generator to the HF-input.

| PM 6681 | Input C | FREQ C |
|------------------|-----------|----------------------|
| Signal generator | Frequency | 1000 \pm 25 MHz |
| | Amplitude | 5.9 \pm 0.5 mV RMS |

Table 6-11 HF-input setup.

• Adjustment

- Turn the potentiometer R61 fully counterclockwise. See Figure 6-11.
- Check that the GATE indicator stops blinking.
- Turn R61 slowly clockwise until the GATE indicator starts blinking.

The input frequency, 1000 \pm 25 MHz shall now be displayed.

4.2 GHz HF-input, PM 9625B

It is not possible to make any adjustments to the PM 9625B.

Therefore, if you suspect any faults, we recommend you to send the unit to the factory for repair.

Contact your local Philips or FLUKE service center.

To verify the 4.2 GHz HF input a sweep frequency synthesizer, (Wiltron 6717B-20) is needed.

4.5 GHz HF-input, PM 9625

It is not possible to make any adjustments to the PM 9625.

Therefore, if you suspect any faults, we recommend you to send the unit to the factory for repair.

Contact your local Philips or FLUKE service center.

To verify the 4.5 GHz HF input a sweep frequency synthesizer, (Wiltron 6717B-20) is needed.

Chapter 7

Replacement Parts

Introduction

Standard Parts

Electrical and mechanical replacement parts can be obtained through your local Philips or Fluke organization or representative. However, many of the standard components can be obtained from other local suppliers. Before purchasing or ordering replacement parts, check the parts list for value, tolerance, rating, and description.

If the value of the physical component differs from what is described in the parts list, you should always replace the part with the same value as originally mounted.

NOTE: Physical size and shape of a component may affect the performance of the instrument, particularly at high frequencies. Always use direct replacements unless it is known that a substitute will not degrade the performance of the instrument.

Special Parts

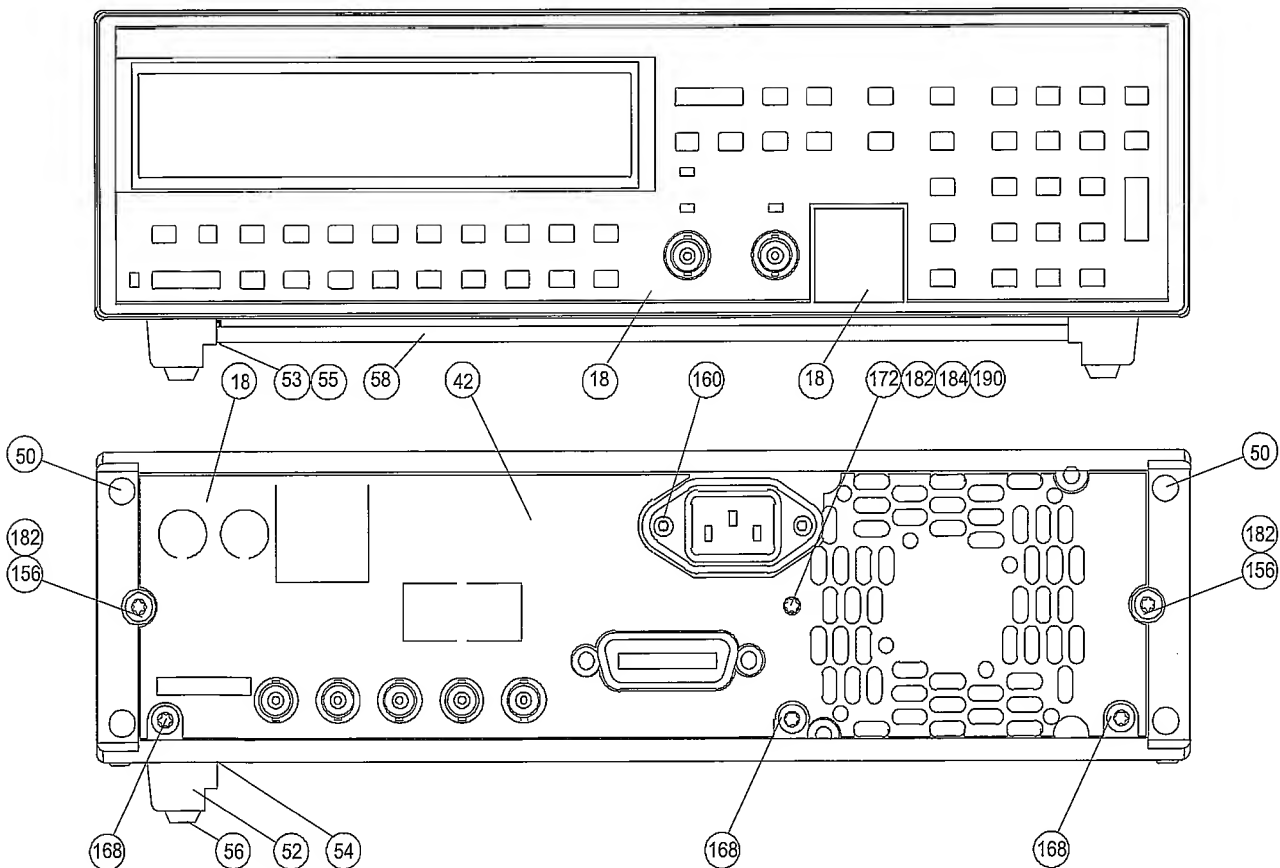
In addition to standard electronic components, the following special components are used:

- Components that are manufactured or selected by Philips to meet specific performance requirements.
- Components that are important for the safety of the instrument.

Both type of components may be replaced only by components obtained through your local Philips or Fluke organization.

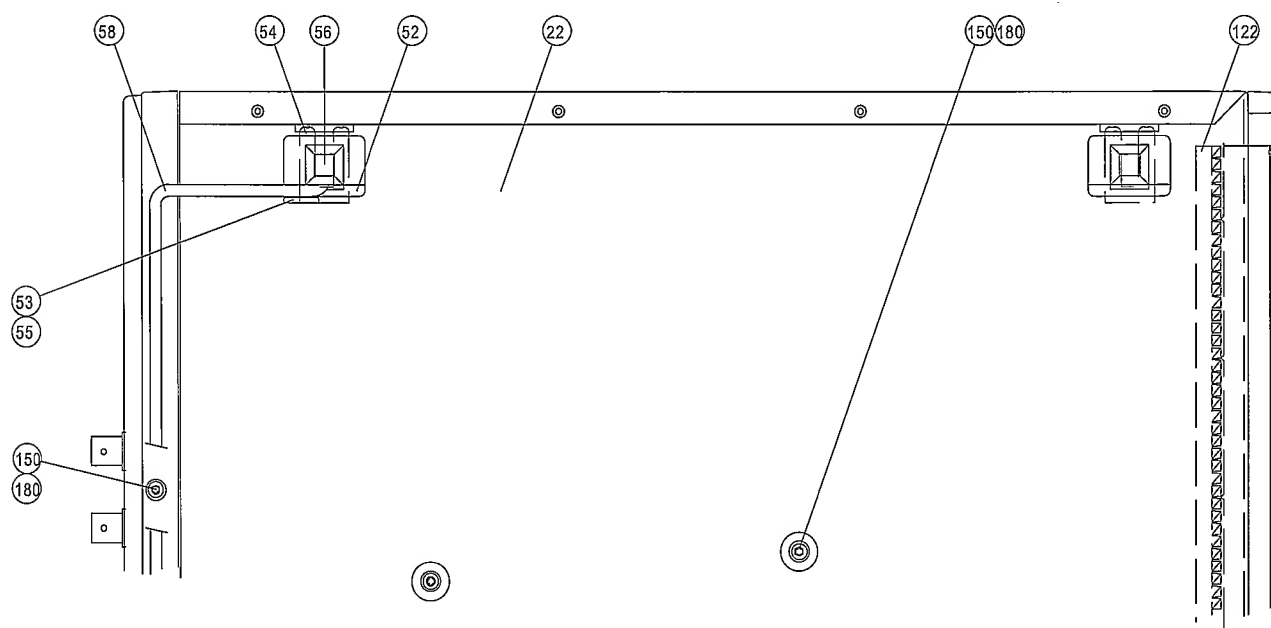
The abovementioned parts are 'Recommended Replacement Parts' and are marked with an 'R' in the ☆ column of the parts list.

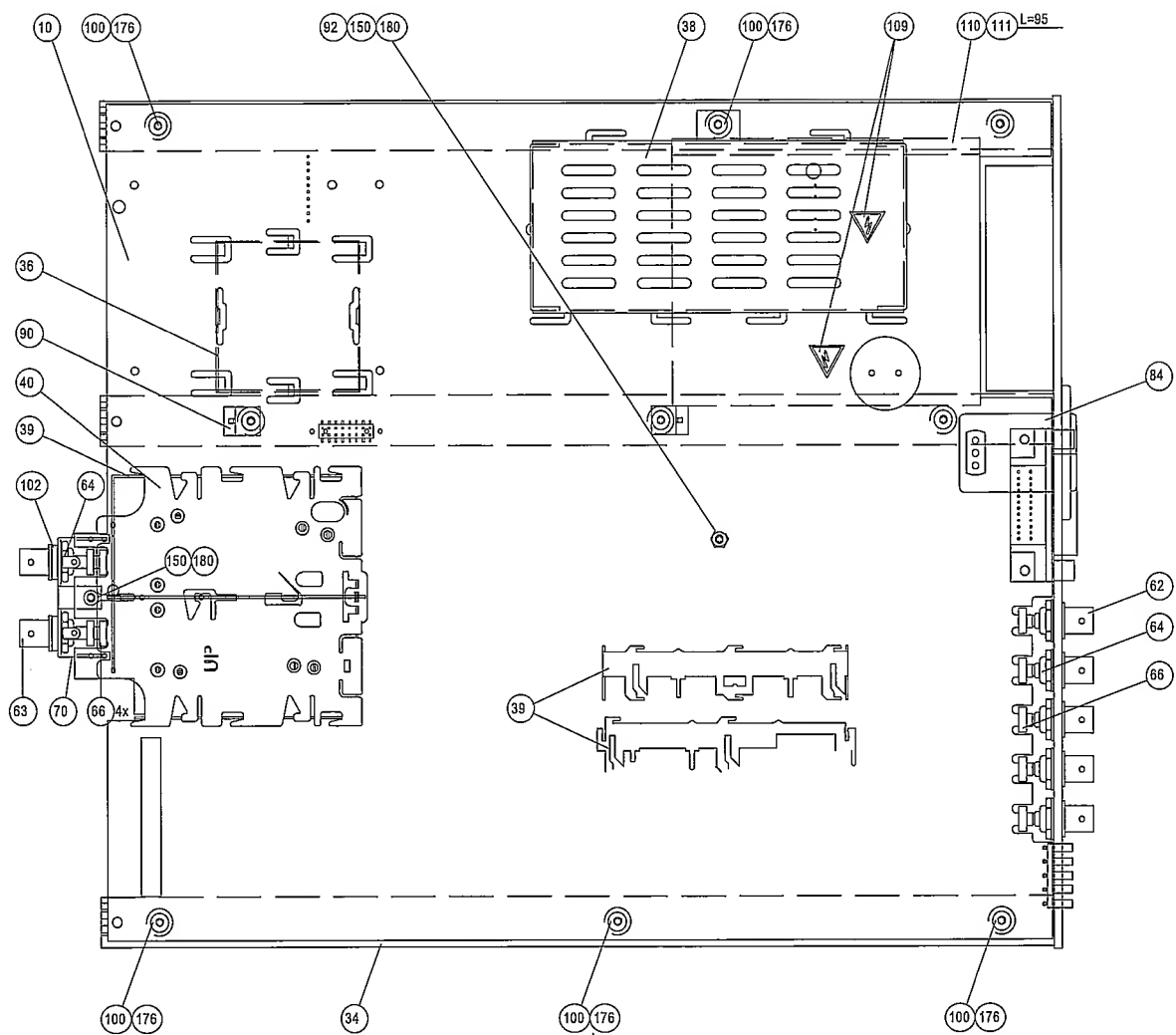
Components marked with a 'P' in the ☆ column are 'Production items' not kept in replacement parts stock. These items can be ordered, but the delivery time is longer than for normal replacement parts.



Mechanical Parts

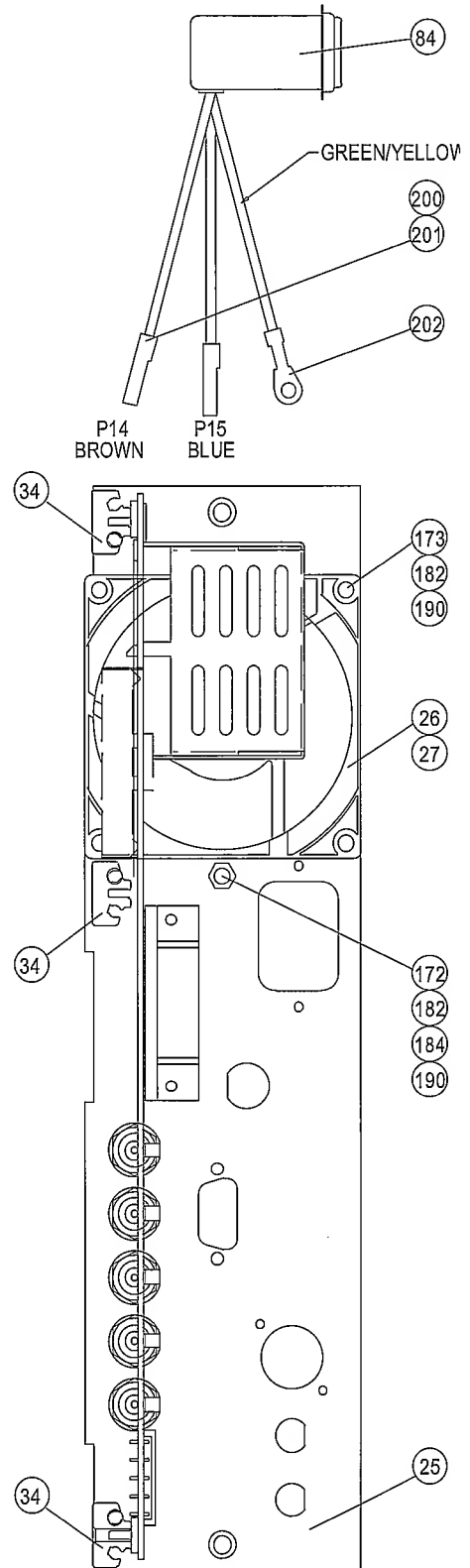
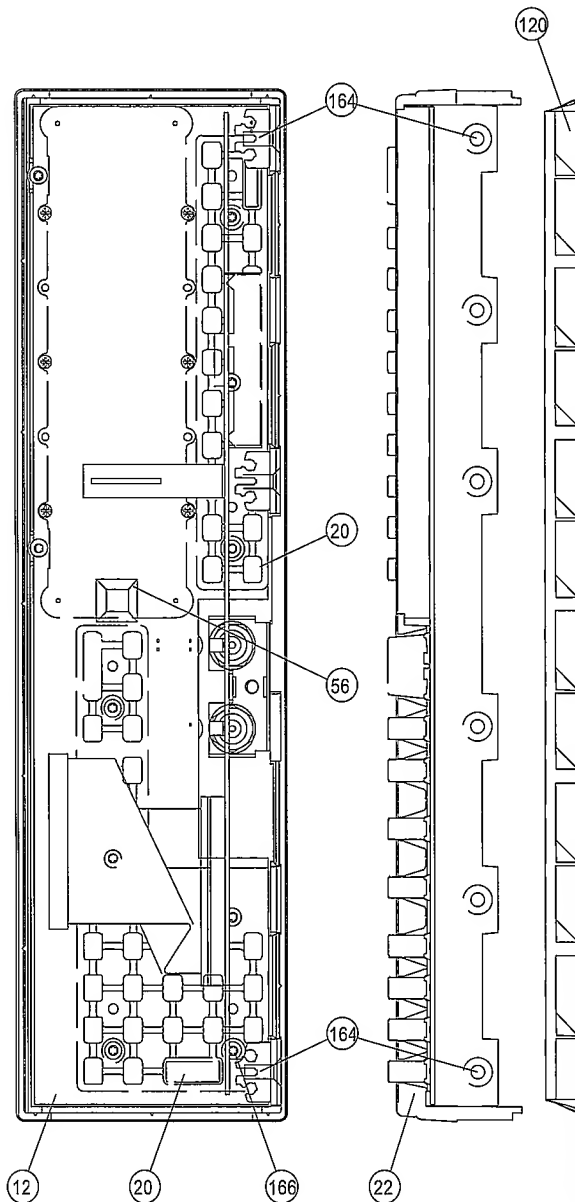
| Pos | Description | Part Number | ☆ | Pos | Description | Part Number | ☆ |
|-----|---------------------------------------|----------------|---|-----|------------------------------------|----------------|---|
| 10 | PC-B 1 ASSY PM6681 BAS81 | 5322 214 91332 | P | 100 | Washer 4.0X10X2 PA6-6 | 5322 532 52364 | P |
| 12 | PC-B 2 ASSY PM6680 DISP80 | 5322 218 70109 | P | 102 | Washer 9.5X13X2.3 PM6680, 81, 85 | 4822 532 10222 | P |
| 18 | Textplate kit PM6681 | 5322 456 10027 | R | 109 | High voltage- WARNING | 5322 456 90366 | P |
| 20 | Rubber keypad PM6680, 81, 85 | 5322 276 80389 | R | 110 | Insulate plate | 5322 466 62465 | P |
| 22 | Cover assy PM6680, 81 | 5322 447 92194 | P | 120 | Front shield PM6680, 81 | 5322 462 50466 | P |
| 25 | Rear plate PM6681 | 5322 447 92202 | P | 122 | Shielding strip 610mm 99-210 | 5322 466 62077 | P |
| 26 | Fan ASF84171 12VDC 80X80X25mm | 5322 361 10539 | | 150 | Screw MRT 3X06 ST FZB TX | 4822 502 11658 | P |
| 27 | Connector 2 POL 640442-2 AWG26 IDT | 5322 265 41371 | | 156 | Screw MRT 4X16 ST FZB TX | 5322 502 21491 | P |
| 34 | Profile-support | 5322 460 60542 | P | 160 | Screw MFT-TT 3X08 STFZB TX | 4822 502 11713 | P |
| 36 | Shield PM6681 | 5322 459 11184 | P | 164 | Screw MFT-TT 4X12 STFZB TX | 5322 502 13553 | P |
| 38 | Shield cover PM6681 | 5322 447 92203 | P | 166 | Screw MRT-TT 3X08 STFZB TX | 4822 502 11691 | P |
| 39 | Shield PM6681 | 5322 459 11185 | P | 168 | Screw MRT-TT 4X16 STFZB TX | 5322 502 13552 | P |
| 40 | Shield cover PM6681 | 5322 447 92204 | P | 172 | Screw MFT 4X10 ST FZB TX | 5322 502 13641 | P |
| 50 | Rearfoot Cabinet M-90 | 5322 462 41719 | R | 173 | Screw MFS 4X35 ST FZB | 5322 502 21492 | P |
| 52 | Bottom foot Cabinet M-90 | 5322 462 41554 | R | 176 | Screw RTK ST3.5X10 FZB TX | 5322 502 30703 | P |
| 53 | Bracket Cabinet | 5322 401 11422 | R | 180 | Spring washer KBA 3.2 ST FZ DIN137 | 4822 530 80173 | P |
| 54 | Spring Cabinet | 5322 492 64745 | R | 182 | Spring washer KBA 4.3 ST FZ DIN137 | 4822 530 80076 | P |
| 56 | Rubber foot SJ-5018 BLACK | 5322 462 44434 | | 184 | Lock washer YT4.3 ST FZ DIN6798A | 4822 530 80083 | P |
| 58 | Bracket stand up PM6680, 81 | 5322 401 11348 | R | 190 | Nut M6M 04 ST FZB | 4822 505 10326 | P |
| 62 | Connector-COAX KC-79-35 | 5322 267 10004 | | 200 | Receptacle 140825-2 2.8X0.8 | 5322 268 10275 | P |
| 63 | COAX Connector | 5322 265 10264 | R | 201 | Protect sleeve 2.8mm N 94610 | 5322 321 40117 | P |
| 66 | Toroid core 30nH RCC9/6/3 4C65 VIOLET | 5322 526 10545 | P | 202 | Cable clip reel SRB-2.5T-M4 | 5322 358 50107 | P |
| 84 | Mains filter 1A FS3514-1/07 | 5322 121 42352 | | 208 | FXF tube 3B 4.3x2 L=7.2 | 4822 526 10097 | |
| 90 | PCB guide PM6680, 81, 85 FOR PRESC | 5322 401 11347 | P | | | | |





Main Board

| Pos | Description | Part Number | ☆ |
|-----|-----------------------------------|----------------|---|
| | PC-B 1 ASSY | 5322 214 91332 | P |
| | Screw MRT 3X08 ST FZB TX | 5322 502 21489 | P |
| | Lock washer YT3.2 ST FZ DIN6798A | 4822 530 80082 | P |
| B1 | Crystal 16 MHz PM5781 HC-49/U | 5322 242 73307 | R |
| B2 | Crystal 10 MHz PM9677 HC-49U | 5322 242 74372 | R |
| B3 | Crystalfilter 100 MHz MF UB | 5322 242 81692 | |
| B4 | Crystalfilter 100 MHz MF UB | 5322 242 81692 | |
| B5 | Crystal 10 MHz HC-49U | 5322 242 81694 | R |
| C1 | Capacitor 2 pF 0.5-2 pF 300V | 5322 124 80335 | |
| C2 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C3 | Capacitor 1 nF 5% 63V NP0 1206 | 4822 122 31746 | |
| C4 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C5 | Capacitor 22 nF 20% 200V 2F4 1206 | 5322 126 10527 | |



| Pos | Description | Part Number | ☆ |
|-----|---|----------------|---|
| C7 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C8 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C9 | Capacitor 2 pF 0.5-2 pF 300V | 5322 124 80335 | |
| C10 | Capacitor 1 nF 5% 63V NP0 1206 | 4822 122 31746 | |
| C11 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C12 | Capacitor 1 nF 5% 63V NP0 1206 | 4822 122 31746 | |
| C13 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C14 | Capacitor 22 nF 20% 200V 2F4 1206 | 5322 126 10527 | |
| C16 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C17 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C18 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C20 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C21 | Capacitor 1 nF 5% 63V NP0 1206 | 4822 122 31746 | |
| C22 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C24 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C25 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C26 | Capacitor 1 nF 5% 63V NP0 1206 | 4822 122 31746 | |
| C29 | Capacitor 10 nF 10% 63V X7R 1206 | 4822 122 32442 | |
| C30 | Capacitor 10 nF 10% 63V X7R 1206 | 4822 122 32442 | |
| C31 | Capacitor 10 nF 10% 63V X7R 1206 | 4822 122 32442 | |
| C32 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C33 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C34 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C35 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C36 | Capacitor 2200 F 20% 16V RAD 2M 12.5X25 | 4822 124 40723 | |
| C37 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C38 | Capacitor 18 pF 2.0-18PF 300V | 5322 125 50051 | |
| C39 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C40 | Capacitor 18 pF 2.0-18PF 300V | 5322 125 50051 | |
| C41 | Capacitor 10 nF 10% 63V X7R 1206 | 4822 122 32442 | |
| C42 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C44 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C46 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C49 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C50 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C51 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C52 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C55 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C57 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C58 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C59 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C60 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C61 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C62 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C63 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C64 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C65 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C66 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C68 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C69 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C71 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C75 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C76 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C77 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C78 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C79 | Capacitor 1 nF 5% 63V NP0 1206 | 4822 122 31746 | |
| C80 | Capacitor 15 µF 20%6.3V 6.0X3.2 MOLD | 5322 124 11418 | |
| C82 | Capacitor 68 F 20% 6.3V SOLID AL | 5322 124 10455 | |
| C87 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |

| Pos | Description | Part Number | ☆ |
|------|--------------------------------------|----------------|---|
| C88 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C89 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C90 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C91 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C92 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C93 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C94 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C95 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C96 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C97 | Capacitor 27 pF 5% 63V NP0 1206 | 4822 122 31825 | |
| C98 | Capacitor 27 pF 5% 63V NP0 1206 | 4822 122 31825 | |
| C99 | Capacitor 6.8 pF 0.5 pF 63V NP0 1206 | 4822 122 32507 | |
| C100 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C101 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C102 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C103 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C104 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C106 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C107 | Capacitor 82 pF 5% 63V NP0 1206 | 4822 122 31839 | |
| C108 | Capacitor 82 pF 5% 63V NP0 1206 | 4822 122 31839 | |
| C109 | Capacitor 22 pF 5% 200V NP0 1206 | 5322 126 13128 | |
| C110 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C111 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C112 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C113 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C114 | Capacitor 10 pF 1, 8-10PF 300V | 5322 125 50049 | |
| C115 | Capacitor 15 pF 2% 100V NP0 2M | 4822 122 31823 | |
| C116 | Capacitor 15 pF 2% 100V NP0 2M | 4822 122 31823 | |
| C117 | Capacitor 1 nF 5% 63V NP0 1206 | 4822 122 31746 | |
| C118 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C119 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C120 | Capacitor 15 µF 20%6.3V 6.0X3.2 MOLD | 5322 124 11418 | |
| C121 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C122 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C125 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C126 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C127 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C128 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C129 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C130 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C131 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C132 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C133 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C134 | Capacitor 10 pF 5% 63V NP0 1206 | 4822 122 31971 | |
| C135 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C137 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C139 | Capacitor 220 pF 20% 200V | 5322 126 13129 | |
| C140 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C143 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C144 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C145 | Capacitor 12 pF 2% 100V NP0 2M | 4822 122 31056 | |
| C146 | Capacitor 15 pF 5% 63V NP0 1206 | 4822 122 32504 | |
| C147 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C148 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C149 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C150 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C151 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C152 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C153 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |

| Pos | Description | Part Number | ☆ |
|------|---|----------------|---|
| C154 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C156 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C157 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C160 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C165 | Capacitor 33 pF 5% 63V NP0 1206 | 4822 126 10324 | |
| C166 | Capacitor 33 pF 5% 63V NP0 1206 | 4822 126 10324 | |
| C167 | Capacitor 1 µF 10% 50V MMKO-5 PETP | 5322 121 42515 | |
| C168 | Capacitor 1 µF 10% 50V MMKO-5 PETP | 5322 121 42515 | |
| C169 | Capacitor 15 µF 20%6.3V 6.0X3.2 MOLD | 5322 124 11418 | |
| C170 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C171 | Capacitor 33 pF 5% 63V NP0 1206 | 4822 126 10324 | |
| C172 | Capacitor 33 pF 5% 63V NP0 1206 | 4822 126 10324 | |
| C173 | Capacitor 2.20 nF PME289MA4220MR04 | 5322 121 43756 | |
| C174 | Capacitor 2.20 nF PME289MA4220MR04 | 5322 121 43756 | |
| C175 | Resistor 0 Ω RC-01 1206 | 4822 051 10008 | |
| C176 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C177 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C178 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C180 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C181 | Capacitor 100 nF 20% 250V | 5322 121 44302 | |
| C182 | Capacitor 1 µF 10% 50V MMKO-5 PETP | 5322 121 42515 | |
| C183 | Capacitor 2.20 nF PME289MA4220MR04 | 5322 121 43756 | |
| C184 | Capacitor 2.20 nF PME289MA4220MR04 | 5322 121 43756 | |
| C186 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C187 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C188 | Capacitor 10 nF 10% 63V X7R 1206 | 4822 122 32442 | |
| C189 | Capacitor 33 nF 5% 50V X7R 1206 | 4822 122 31981 | |
| C190 | Capacitor 33 pF 5% 63V NP0 1206 | 4822 126 10324 | |
| C191 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C192 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C193 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C194 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C196 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C197 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C201 | Capacitor 47 pF 5% 63V NP0 1206 | 4822 122 31772 | |
| C202 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C302 | Capacitor 2200 F 20% 16V RAD 2M 12.5X25 | 4822 124 40723 | |
| C303 | Capacitor 68 F 20% 6.3V SOLID AL | 5322 124 10455 | |
| C304 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C305 | Capacitor 68 F 20% 6.3V SOLID AL | 5322 124 10455 | |
| C306 | Capacitor 2200 F 20% 16V RAD 2M 12.5X25 | 4822 124 40723 | |
| C307 | Capacitor 15 µF 20%6.3V 6.0X3.2 MOLD | 5322 124 11418 | |
| C308 | Capacitor 15 µF 20%6.3V 6.0X3.2 MOLD | 5322 124 11418 | |
| C310 | Capacitor 2.20 µF 20%6.3V 3.2X1.6 MOLD | 5322 124 10685 | |
| C311 | Capacitor 15 µF 20%6.3V 6.0X3.2 MOLD | 5322 124 11418 | |
| C313 | Capacitor 6.80 µF 20% 16V 6.0X3.2 MOLD | 5322 124 10687 | |
| C314 | Capacitor 15 µF 20%6.3V 6.0X3.2 MOLD | 5322 124 11418 | |
| C315 | Capacitor 6.80 µF 20% 16V 6.0X3.2 MOLD | 5322 124 10687 | |
| C316 | Capacitor 6.80 µF 20% 16V 6.0X3.2 MOLD | 5322 124 10687 | |
| C317 | Capacitor 33 F 20% 10V SOLID AL | 5322 124 11084 | |
| C318 | Capacitor 15 µF 20%6.3V 6.0X3.2 MOLD | 5322 124 11418 | |
| C319 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C320 | Capacitor 68 F 20% 6.3V SOLID AL | 5322 124 10455 | |
| C321 | Capacitor 15 µF 20%6.3V 6.0X3.2 MOLD | 5322 124 11418 | |
| C323 | Capacitor 15 µF 20%6.3V 6.0X3.2 MOLD | 5322 124 11418 | |
| C324 | Capacitor 68 F 20% 6.3V SOLID AL | 5322 124 10455 | |
| C325 | Capacitor 15 µF 20%6.3V 6.0X3.2 MOLD | 5322 124 11418 | |
| C326 | Capacitor 15 µF 20%6.3V 6.0X3.2 MOLD | 5322 124 11418 | |
| C327 | Capacitor 68 F 20% 6.3V SOLID AL | 5322 124 10455 | |

| Pos | Description | Part Number | ☆ |
|------|--|----------------|---|
| C328 | Capacitor 68 F 20% 6.3V SOLID AL | 5322 124 10455 | |
| C329 | Capacitor 68 F 20% 6.3V SOLID AL | 5322 124 10455 | |
| C330 | Capacitor 270 F SMG 20% 400V 25X45 | 5322 124 80334 | |
| C334 | Capacitor 68 F 20% 6.3V SOLID AL | 5322 124 10455 | |
| C335 | Capacitor 6.80 µF 20% 16V 6.0X3.2 MOLD | 5322 124 10687 | |
| C336 | Capacitor 15 µF 20%6.3V 6.0X3.2 MOLD | 5322 124 11418 | |
| C338 | Capacitor 6.80 µF 20% 16V 6.0X3.2 MOLD | 5322 124 10687 | |
| C339 | Capacitor 6.80 µF 20% 16V 6.0X3.2 MOLD | 5322 124 10687 | |
| C340 | Capacitor 470 F 20% 35V 2M 12.5x20 | 5322 126 13131 | |
| C341 | Capacitor 15 µF 20%6.3V 6.0X3.2 MOLD | 5322 124 11418 | |
| C342 | Capacitor 15 µF 20%6.3V 6.0X3.2 MOLD | 5322 124 11418 | |
| C344 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C345 | Capacitor 22 pF 5% 200V NP0 1206 | 5322 126 13128 | |
| C346 | Capacitor 10 pF 1, 8-10PF 300V | 5322 125 50049 | |
| C347 | Capacitor 10 pF 1, 8-10PF 300V | 5322 125 50049 | |
| C348 | Capacitor 10 pF 1, 8-10PF 300V | 5322 125 50049 | |
| C349 | Capacitor 100 pF 5% 63V NP0 1206 | 4822 122 31765 | |
| C350 | Capacitor 10 nF 10% 63V X7R 1206 | 4822 122 32442 | |
| C351 | Capacitor 10 pF 1, 8-10PF 300V | 5322 125 50049 | |
| C352 | Capacitor 100 pF 5% 63V NP0 1206 | 4822 122 31765 | |
| C353 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C354 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C355 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C356 | Capacitor 18 pF 2.0-18PF 300V | 5322 125 50051 | |
| C357 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C358 | Capacitor 33 pF 5% 63V NP0 1206 | 4822 126 10324 | |
| C359 | Capacitor 15 pF 5% 63V NP0 1206 | 4822 122 32504 | |
| C360 | Capacitor 2.2 pF 0.25pF 63V NP0 1206 | 4822 863 15228 | |
| C361 | Capacitor 33 pF 5% 63V NP0 1206 | 4822 126 10324 | |
| C362 | Capacitor 15 pF 5% 63V NP0 1206 | 4822 122 32504 | |
| C363 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C364 | Capacitor 6.8 pF 0.5pF 63V NP0 1206 | 4822 122 32507 | |
| C367 | Capacitor 2.2 pF0.25pF 63V NP0 1206 | 4822 863 15228 | |
| C368 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C369 | Capacitor 1 nF 5% 63V NP0 1206 | 4822 122 31746 | |
| C370 | Capacitor 1 nF 5% 63V NP0 1206 | 4822 122 31746 | |
| C371 | Capacitor 220 pF 20% 200V | 5322 126 13129 | |
| C372 | Capacitor 33 nF 10% 50V X7R 1206 | 4822 122 31981 | |
| C373 | Capacitor 33 nF 10% 50V X7R 1206 | 4822 122 31981 | |
| C374 | Capacitor 33 nF 10% 50V X7R 1206 | 4822 122 31981 | |
| C375 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C376 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C377 | Capacitor 47 nF 10% 250V POLYCARB | 4822 121 41676 | |
| C378 | Capacitor 330 nF 20% 250V | 5322 121 44222 | |
| C379 | Capacitor 220 pF 20% 200V | 5322 126 13129 | |
| C381 | Capacitor 100 µF 20% 35V 2M 8.2x11 | 5322 124 40852 | |
| C382 | Capacitor 220 pF 20% 200V | 5322 126 13129 | |
| C383 | Capacitor 100 pF 5% 63V NP0 1206 | 4822 122 31765 | |
| C384 | Capacitor 22 pF 5% 200V NP0 1206 | 5322 126 13128 | |
| C385 | Capacitor 4.7 nF 10% 63V X7R 1206 | 4822 122 31784 | |
| C386 | Capacitor 4.7 nF 10% 63V X7R 1206 | 4822 122 31784 | |
| C387 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C388 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C389 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |
| C390 | Capacitor 470 F 20% 35V 2M 12.5x20 | 5322 126 13131 | |
| C391 | Capacitor 470 F 20% 35V 2M 12.5x20 | 5322 126 13131 | |
| C392 | Capacitor 10000 µF 20% 6.3V 3M 18x35 | 5322 124 80821 | |
| C393 | Capacitor 1 nF 5% 63V NP0 1206 | 4822 122 31746 | |
| C394 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | |

| Pos | Description | Part Number | ☆ | Pos | Description | Part Number | ☆ |
|------|--------------------------------------|----------------|---|------|--------------------------------------|----------------|---|
| C395 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | | D38 | Diode 0.10A BAV99 SOT23 | 5322 130 34337 | |
| C396 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | | D40 | Bridge rectif 4A KBU4K 800V | 4822 130 80497 | |
| C397 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | | D41 | Diode 0.25A BAW56 70V SOT23 | 5322 130 30691 | |
| C398 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | | D42 | Diode 7A BYW29/200 TO-220AC | 5322 130 32328 | |
| C403 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | | D43 | Heat sink 16\$/KW TO220 | 5322 255 41313 | P |
| C404 | Capacitor 12 pF 5% 63V NP0 1206 | 4822 122 32139 | | D43 | Diode 7.5A MBR760 60V TO220 | 5322 130 83602 | |
| C405 | Capacitor 12 pF 5% 63V NP0 1206 | 4822 122 32139 | | D44 | Diode 0.10A BAV99 SOT23 | 5322 130 34337 | |
| C406 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | | D45 | Diode 0.10A BAV99 SOT23 | 5322 130 34337 | |
| C407 | Capacitor 100 pF 5% 63V NP0 1206 | 4822 122 31765 | | D47 | Diode 0.35 W BZX84-C8V2 SOT23 | 5322 130 80255 | |
| C408 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | | D48 | Diode BYV26E DOD57 | 4822 130 60815 | |
| C409 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | | D49 | Diode 0.35 W BZX84-C18 SOT23 | 5322 130 80212 | |
| C410 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | | D50 | Diode 0.2A BAV23 200V SOT143 | 5322 130 33764 | |
| C411 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | | D52 | Diode 0.35 W BZX84-C18 SOT23 | 5322 130 80212 | |
| C412 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | | D53 | Diode 0.35 W BZX84-C18 SOT23 | 5322 130 80212 | |
| C415 | Capacitor 5.6 pF 0.5 pF 63V NP0 1206 | 4822 122 32506 | | D54 | Diode 0.35 W BZX84-C8V2 SOT23 | 5322 130 80255 | |
| C416 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | | D55 | Diode 0.2A BAV23 200V SOT143 | 5322 130 33764 | |
| C417 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | | D56 | Diode 0.2A BAV23 200V SOT143 | 5322 130 33764 | |
| C418 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | | D57 | Heat sink 16\$/KW TO220 | 5322 255 41313 | P |
| C419 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | | D57 | Diode 7A BYW29/200 TO-220AC | 5322 130 32328 | |
| C420 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | | D58 | Diode 0.10A BAV99 SOT23 | 5322 130 34337 | |
| C421 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | | D59 | Diode 0.10A BAR42 30V SOT23 | 5322 130 83586 | |
| C426 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | | D60 | Diode 0.35W BZX84-B5V6 2% SOT23 | 4822 130 33004 | |
| C427 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | | D61 | Diode 0.10A BAV99 SOT23 | 5322 130 34337 | |
| C428 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | | D62 | Diode 0.10A BAV99 SOT23 | 5322 130 34337 | |
| C429 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | | D64 | Diode 0.10A BAV99 SOT23 | 5322 130 34337 | |
| C430 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | | D66 | Diode 0.2A BAV23 200V SOT143 | 5322 130 33764 | |
| C432 | Capacitor 18 pF 2.0-18PF 300V | 5322 125 50051 | | F1 | Fuse 1.6A 5X20 T FST034.3119 | 4822 253 30024 | |
| C436 | Capacitor 18 pF 2.0-18 pF 300V | 5322 125 50051 | | F1 | Fuse holder 011 656 5X20mm | 4822 256 30139 | |
| C441 | Capacitor 12 pF 5% 63V NP0 1206 | 4822 122 32139 | | G1 | Battery holder 20mm BH800 | 5322 256 60311 | |
| C442 | Capacitor 12 pF 5% 63V NP0 1206 | 4822 122 32139 | | G1 | Battery 3V BR2032 190mAh 20x3.2 | 4822 138 10082 | P |
| C445 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | | GND5 | Connector 3 POL F095 single row | 5322 290 60445 | |
| C447 | Capacitor 33 pF 5% 63V NP0 1206 | 4822 126 10324 | | GND6 | Connector 3 POL F095 single row | 5322 290 60445 | |
| C448 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | | GND7 | Connector 3 POL F095 SINGLE ROW | 5322 290 60445 | |
| C449 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | | J12 | Connector 3 POL F095 single row | 5322 290 60445 | |
| C450 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | | J12 | Connector 2POL F095 jumper grey | 5322 263 50101 | |
| C451 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | | J15 | Connector 2POL F095 jumper grey | 5322 263 50101 | |
| C452 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | | J15 | Connector 3 POL F095 single row | 5322 290 60445 | |
| C453 | Capacitor 100 nF 10% 63V X7R 1206 | 4822 122 33496 | | J17 | Cable assy PM6681 | 5322 321 62336 | P |
| C454 | Capacitor 1 nF 5% 63V NP0 1206 | 4822 122 31746 | | J18 | Connector 2 POL F095 single row | 5322 265 44074 | |
| D4 | Diode 0.10A BAV99 SOT23 | 5322 130 34337 | | J19 | Connector 24 POL 57LE-20240-77OOD35G | 5322 267 60148 | |
| D5 | Diode 0.10A BAV99 SOT23 | 5322 130 34337 | | K1 | Relay 2p vx V23042-A1003-B101 | 5322 280 60557 | R |
| D6 | Diode 0.10A BAV99 SOT23 | 5322 130 34337 | | K2 | Relay TQ2-5 SV/1A 2pol vx 14X9X5m | 5322 280 20514 | R |
| D7 | Diode 0.10A BAV99 SOT23 | 5322 130 34337 | | K3 | Relay TQ2-5 SV/1A 2pol vx 14X9X5m | 5322 280 20514 | R |
| D8 | Diode 0.10A BAT18 35V 1 pF SOT23 | 5322 130 32076 | | K4 | Relay TQ2-5 SV/1A 2pol vx 14X9X5m | 5322 280 20514 | R |
| D9 | Diode 0.10A BAT18 35V 1 pF SOT23 | 5322 130 32076 | | K5 | Relay TQ2-5 SV/1A 2pol vx 14X9X5m | 5322 280 20514 | R |
| D10 | Diode 0.10A BAT18 35V 1 pF SOT23 | 5322 130 32076 | | K6 | Relay TQ2-5 SV/1A 2pol vx 14X9X5m | 5322 280 20514 | R |
| D11 | Diode 0.10A BAT18 35V 1 pF SOT23 | 5322 130 32076 | | K7 | Relay TQ2-5 SV/1A 2pol vx 14X9X5m | 5322 280 20514 | R |
| D12 | Diode 0.10A BAV99 SOT23 | 5322 130 34337 | | K8 | Relay TQ2-5 SV/1A 2pol vx 14X9X5m | 5322 280 20514 | R |
| D13 | Diode 0.10A BAV99 SOT23 | 5322 130 34337 | | K9 | Relay TQ2-5 SV/1A 2pol vx 14X9X5m | 5322 280 20514 | R |
| D18 | Diode 0.10A BAV99 SOT23 | 5322 130 34337 | | L1 | Choke 220 µH 10% NL453232T-221K | 5322 157 61918 | |
| D23 | Diode 0.10A BAV99 SOT23 | 5322 130 34337 | | L3 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| D24 | Diode 0.10A BAR42 30V SOT23 | 5322 130 83586 | | L4 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| D26 | Diode 0.10A BAV99 SOT23 | 5322 130 34337 | | L5 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| D27 | Diode 0.10A BAV99 SOT23 | 5322 130 34337 | | L7 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| D30 | Diode 0.15A BAS45 125V DO-35 | 5322 130 32256 | | L8 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| D31 | Diode 0.10A BAR42 30V SOT23 | 5322 130 83586 | | L9 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| D32 | Diode 0.10A BAV99 SOT23 | 5322 130 34337 | | L10 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| D33 | Diode 0.10A BAV99 SOT23 | 5322 130 34337 | | L11 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| D35 | Diode 0.10A BAV99 SOT23 | 5322 130 34337 | | L12 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |

| Pos | Description | Part Number | ☆ |
|------|--|----------------|---|
| L13 | Choke 1 μ H 10% MLF3216D1R0K | 5322 157 62555 | |
| L14 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| L15 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| L16 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| L17 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| L18 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| L19 | Choke 33 μ H TSL0807-330K1R2 | 5322 157 53568 | |
| L20 | Choke 10 mH B82722-J2102-N1 1A | 5322 157 70143 | |
| L21 | Choke 10 μ H TSL1110-100M3R2 | 5322 157 52513 | |
| L22 | Choke 10 μ H TSL1110-100M3R2 | 5322 157 52513 | |
| L23 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| L24 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| L25 | Choke 0.15 μ H 10% MLF3216DR15K | 5322 157 71041 | |
| L26 | Choke 0.15 μ H 10% MLF3216DR15K | 5322 157 71041 | |
| L27 | Choke 0.15 μ H 10% MLF3216DR15K | 5322 157 71041 | |
| L28 | Choke 0.15 μ H 10% MLF3216DR15K | 5322 157 71041 | |
| L29 | Choke 0.15 μ H 10% MLF3216DR15K | 5322 157 71041 | |
| L30 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| L31 | Choke 4.70 μ H 10% MLF3216A4R7KT | 4822 157 70975 | |
| L32 | Choke 4.70 μ H 10% MLF3216A4R7KT | 4822 157 70975 | |
| L33 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| L39 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| L40 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| L41 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| L42 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| L43 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| L45 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| L46 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| L47 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| L48 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| L49 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| L50 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| L51 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| L52 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| L53 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| L54 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| L55 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| L56 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| L57 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| L58 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| L59 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| L60 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| L61 | Choke 4S2 3.5X6MM 80 Ω at 100 MHz | 5322 157 61928 | |
| P7 | Connector 3 POL F095 SINGLE ROW | 5322 290 60445 | |
| P18 | Flat pin 2.8mm E184/8 LESA SN BAND | 5322 290 34064 | |
| P19 | Flat pin 2.8mm E184/8 LESA SN BAND | 5322 290 34064 | |
| P20 | Connector 16 POL F095 DOUBLE ROW | 5322 265 40262 | |
| P21 | Connector 10 POL 22-03-2101 4030-10A | 5322 265 64028 | |
| P25 | Connector 5 POL 334 2142 2 05 53 0 | 5322 265 41369 | |
| P109 | Soldering tag 9.6X15/15 MS FS | 5322 290 30318 | |
| R4 | Resistor 47.0 k Ω 0.5% 1/8 W RC-03G 1206 | 5322 117 10857 | |
| R5 | Resistor 330 k Ω 1% 1/8 W 100PPM 1206 | 5322 117 10969 | |
| R6 | Resistor 470.0 k Ω 0.5% 1/8 W RC-03G 1206 | 5322 117 10858 | |
| R7 | Resistor 56.0 k Ω 1% 1/8 W 100PPM 1206 | 5322 117 10971 | |
| R8 | Resistor 470.0 k Ω 0.5% 1/8 W RC-03G 1206 | 5322 117 10858 | |
| R10 | Resistor 100 k Ω 1% 1/8 W 100PPM 1206 | 4822 051 51004 | |
| R11 | Resistor 2.70 k Ω 1% 1/8 W 100PPM 1206 | 4822 051 52702 | |

| Pos | Description | Part Number | ☆ |
|-----|--|----------------|---|
| R12 | Resistor 1.80 k Ω 1% 1/8 W 100PPM 1206 | 4822 051 10182 | |
| R13 | Resistor 220.0 Ω 1% 1/8 W 100PPM 1206 | 4822 051 52201 | |
| R14 | Resistor 1.50 k Ω 1% 1/8 W 100PPM 1206 | 4822 051 51502 | |
| R15 | Resistor 1.00 k Ω 1% 1/8 W 100PPM 1206 | 4822 051 51002 | |
| R16 | Resistor 470.0 k Ω 0.5% 1/8 W RC-03G | 5322 117 10858 | |
| R17 | Resistor 470.0 k Ω 0.5% 1/8 W RC-03G | 5322 117 10858 | |
| R18 | Potentiometer 20 k Ω 10% 3323P-1-203-10 | 5322 101 11074 | |
| R19 | Resistor 10.0 k Ω 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R20 | Resistor 390 Ω 1% 1/8 W 100PPM 1206 | 4822 051 53901 | |
| R21 | Resistor 390 Ω 1% 1/8 W 100PPM 1206 | 4822 051 53901 | |
| R22 | Resistor 470.0 k Ω 0.5% 1/8 W RC-03G | 5322 117 10858 | |
| R23 | Resistor 470.0 k Ω 0.5% 1/8 W RC-03G 1206 | 5322 117 10858 | |
| R24 | Resistor 15.0 k Ω 1% 1/8 W 100PPM 1206 | 5322 116 82261 | |
| R25 | Resistor 330 Ω 1% 1/8 W 100PPM 1206 | 4822 051 53301 | |
| R26 | Resistor 330 Ω 1% 1/8 W 100PPM 1206 | 4822 051 53301 | |
| R27 | Resistor 470.0 k Ω 0.5% 1/8 W RC-03G 1206 | 5322 117 10858 | |
| R28 | Resistor 56.0 k Ω 1% 1/8 W 100PPM 1206 | 5322 117 10971 | |
| R29 | Resistor 470.0 k Ω 0.5% 1/8 W RC-03G 1206 | 5322 117 10858 | |
| R30 | Resistor 47.0 k Ω 0.5% 1/8 W RC-03G 1206 | 5322 117 10857 | |
| R31 | Resistor 330 k Ω 1% 1/8 W 100PPM 1206 | 5322 117 10969 | |
| R32 | Resistor 470.0 k Ω 0.5% 1/8 W RC-03G 1206 | 5322 117 10858 | |
| R34 | Resistor 56.0 k Ω 1% 1/8 W 100PPM 1206 | 5322 117 10971 | |
| R35 | Resistor 470.0 k Ω 0.5% 1/8 W RC-03G 1206 | 5322 117 10858 | |
| R36 | Resistor 100 k Ω 1% 1/8 W 100PPM 1206 | 4822 051 51004 | |
| R37 | Resistor 2.70 k Ω 1% 1/8 W 100PPM 1206 | 4822 051 52702 | |
| R38 | Resistor 1.80 k Ω 1% 1/8 W 100PPM 1206 | 4822 051 10182 | |
| R39 | Resistor 220.0 Ω 1% 1/8 W 100PPM 1206 | 4822 051 52201 | |
| R40 | Resistor 1.50 k Ω 1% 1/8 W 100PPM 1206 | 4822 051 51502 | |
| R41 | Resistor 1.00 k Ω 1% 1/8 W 100PPM 1206 | 4822 051 51002 | |
| R42 | Resistor 470.0 k Ω 0.5% 1/8 W RC-03G 1206 | 5322 117 10858 | |
| R43 | Resistor 470.0 k Ω 0.5% 1/8 W RC-03G 1206 | 5322 117 10858 | |
| R44 | Potentiometer 20 k Ω 10% 3323P-1-203-10 | 5322 101 11074 | |
| R45 | Resistor 10.0 k Ω 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R46 | Resistor 390 Ω 1% 1/8 W 100PPM 1206 | 4822 051 53901 | |
| R47 | Resistor 390 Ω 1% 1/8 W 100PPM 1206 | 4822 051 53901 | |
| R48 | Resistor 470.0 k Ω 0.5% 1/8 W RC-03G 1206 | 5322 117 10858 | |
| R49 | Resistor 470.0 k Ω 0.5% 1/8 W RC-03G 1206 | 5322 117 10858 | |
| R50 | Resistor 15.0 k Ω 1% 1/8 W 100PPM 1206 | 5322 116 82261 | |
| R51 | Resistor 330 Ω 1% 1/8 W 100PPM 1206 | 4822 051 53301 | |
| R52 | Resistor 470.0 k Ω 0.5% 1/8 W RC-03G 1206 | 5322 117 10858 | |
| R53 | Resistor 56.0 k Ω 1% 1/8 W 100PPM 1206 | 5322 117 10971 | |
| R54 | Resistor 470.0 k Ω 0.5% 1/8 W RC-03G 1206 | 5322 117 10858 | |
| R55 | Resistor 150 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51501 | |
| R56 | Resistor 33 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10339 | |
| R57 | Resistor 10.0 k Ω 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R58 | Resistor 10.0 k Ω 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R59 | Resistor 10.0 k Ω 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R60 | Resistor 470 Ω 1% 1/8 W 100PPM 1206 | 4822 051 54701 | |
| R61 | Resistor 390 Ω 1% 1/8 W 100PPM 1206 | 4822 051 53901 | |
| R62 | Resistor 390 Ω 1% 1/8 W 100PPM 1206 | 4822 051 53901 | |
| R63 | Resistor 220.0 Ω 1% 1/8 W 100PPM 1206 | 4822 051 52201 | |
| R64 | Resistor 68 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10689 | |
| R65 | Resistor 68 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10689 | |
| R66 | Resistor 47 Ω 1% 1/8 W 100PPM 1206 | 5322 116 80448 | |
| R67 | Resistor 47 Ω 1% 1/8 W 100PPM 1206 | 5322 116 80448 | |
| R68 | Resistor 1.00 k Ω 1% 1/8 W 100PPM 1206 | 4822 051 51002 | |
| R69 | Resistor 82 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10829 | |

| Pos | Description | Part Number | ☆ |
|------|---------------------------------------|----------------|---|
| R70 | Resistor 150 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51501 | |
| R71 | Resistor 33 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10339 | |
| R72 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R73 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R74 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R75 | Resistor 470 Ω 1% 1/8 W 100PPM 1206 | 4822 051 54701 | |
| R76 | Resistor 390 Ω 1% 1/8 W 100PPM 1206 | 4822 051 53901 | |
| R77 | Resistor 390 Ω 1% 1/8 W 100PPM 1206 | 4822 051 53901 | |
| R78 | Resistor 220.0 Ω 1% 1/8 W 100PPM 1206 | 4822 051 52201 | |
| R79 | Resistor 68 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10689 | |
| R80 | Resistor 68 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10689 | |
| R81 | Resistor 47 Ω 1% 1/8 W 100PPM 1206 | 5322 116 80448 | |
| R82 | Resistor 47 Ω 1% 1/8 W 100PPM 1206 | 5322 116 80448 | |
| R83 | Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51002 | |
| R84 | Resistor 82 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10829 | |
| R85 | Resistor 47 Ω 1% 1/8 W 100PPM 1206 | 5322 116 80448 | |
| R86 | Resistor 47 Ω 1% 1/8 W 100PPM 1206 | 5322 116 80448 | |
| R87 | Resistor 82 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10829 | |
| R88 | Resistor 82 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10829 | |
| R90 | Resistor 82 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10829 | |
| R91 | Resistor 15.0 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10159 | |
| R92 | Resistor 82 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10829 | |
| R94 | Resistor 15.0 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10159 | |
| R95 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | |
| R96 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | |
| R97 | Resistor 47 Ω 1% 1/8 W 100PPM 1206 | 5322 116 80448 | |
| R98 | Resistor 1.0 Ω 1% 1/8 W 100PPM 1206 | 5322 117 10967 | |
| R99 | Resistor 47 Ω 1% 1/8 W 100PPM 1206 | 5322 116 80448 | |
| R100 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | |
| R101 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | |
| R102 | Resistor 82 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10829 | |
| R103 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | |
| R104 | Resistor 120 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10121 | |
| R105 | Resistor 120 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10121 | |
| R108 | Resistor 10 MΩ 10% 1/4 W RC-01 1206 | 4822 051 10106 | |
| R109 | Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51002 | |
| R110 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | |
| R111 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | |
| R112 | Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51002 | |
| R113 | Resistor 10 MΩ 10% 1/4 W RC-01 1206 | 4822 051 10106 | |
| R116 | Resistor 10.0 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10109 | |
| R118 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | |
| R124 | Resistor 10.0 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10109 | |
| R125 | Resistor 12.0 kΩ 1% 1/8 W 100PPM 1206 | 5322 117 10968 | |
| R126 | Resistor 8.20 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 10822 | |
| R127 | Resistor 220.0 Ω 1% 1/8 W 100PPM 1206 | 4822 051 52201 | |
| R128 | Resistor 680 Ω 1% 1/8 W 100PPM 1206 | 4822 051 56801 | |
| R129 | Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51002 | |
| R131 | Resistor 27 Ω 1% 1/8 W 100PPM 1206 | 5322 116 82262 | |
| R132 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | |
| R133 | Resistor 27 Ω 1% 1/8 W 100PPM 1206 | 5322 116 82262 | |
| R134 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | |
| R135 | Resistor 39 Ω 1% 1/8 W 100PPM 1206 | 5322 116 82263 | |
| R136 | Resistor 39 Ω 1% 1/8 W 100PPM 1206 | 5322 116 82263 | |
| R137 | Resistor 39 Ω 1% 1/8 W 100PPM 1206 | 5322 116 82263 | |
| R138 | Resistor 39 Ω 1% 1/8 W 100PPM 1206 | 5322 116 82263 | |
| R139 | Resistor 39 Ω 1% 1/8 W 100PPM 1206 | 5322 116 82263 | |

| Pos | Description | Part Number | ☆ | Pos | Description | Part Number | ☆ |
|------|---------------------------------------|----------------|---|------|--|----------------|---|
| R201 | Resistor 47 Ω 1% 1/8 W 100PPM 1206 | 5322 116 80448 | | R265 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R202 | Resistor 47 Ω 1% 1/8 W 100PPM 1206 | 5322 116 80448 | | R266 | Resistor 27 Ω 1% 1/8 W 100PPM 1206 | 5322 116 82262 | |
| R203 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | | R269 | Resistor 3.30 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 53302 | |
| R204 | Resistor 100 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51004 | | R270 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | |
| R206 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | | R271 | Resistor 47 Ω 1% 1/8 W 100PPM 1206 | 5322 116 80448 | |
| R207 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | | R273 | Resistor 22 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10229 | |
| R208 | Resistor 47 Ω 1% 1/8 W 100PPM 1206 | 5322 116 80448 | | R274 | Resistor 22 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10229 | |
| R209 | Resistor 56 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10569 | | R276 | Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51002 | |
| R210 | Resistor 56 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10569 | | R277 | Resistor 180.0 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10181 | |
| R211 | Resistor 56 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10569 | | R278 | Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51002 | |
| R212 | Resistor 56 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10569 | | R279 | Resistor 680 Ω 1% 1/8 W 100PPM 1206 | 4822 051 56801 | |
| R216 | Resistor 0 Ω RC-01 1206 | 4822 051 10008 | | R280 | Resistor 27 Ω 1% 1/8 W 100PPM 1206 | 5322 116 82262 | |
| R217 | Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51002 | | R282 | Resistor 220.0 Ω 1% 1/8 W 100PPM 1206 | 4822 051 52201 | |
| R220 | Resistor 820 Ω 1% 1/8 W 100PPM 1206 | 5322 116 82264 | | R283 | Resistor 470 Ω 1% 1/8 W 100PPM 1206 | 4822 051 54701 | |
| R221 | Resistor 56 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10569 | | R284 | Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51002 | |
| R222 | Resistor 56 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10569 | | R285 | Resistor 47 Ω 1% 1/8 W 100PPM 1206 | 5322 116 80448 | |
| R223 | Resistor 56 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10569 | | R286 | Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51002 | |
| R224 | Resistor 56 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10569 | | R287 | Resistor 33 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10339 | |
| R225 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | | R288 | Resistor 33 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10339 | |
| R226 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | | R289 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R227 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | | R290 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R228 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | | R293 | Resistor 120 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10121 | |
| R229 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | | R294 | Resistor 120 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10121 | |
| R230 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | | R295 | Resistor 33 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10339 | |
| R231 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | | R296 | Resistor 33 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10339 | |
| R232 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | | R297 | Resistor 220.0 Ω 1% 1/8 W 100PPM 1206 | 4822 051 52201 | |
| R233 | Resistor 270 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10271 | | R298 | Resistor 220.0 Ω 1% 1/8 W 100PPM 1206 | 4822 051 52201 | |
| R234 | Resistor 56 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10569 | | R299 | Resistor 6.80 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 10682 | |
| R235 | Resistor 56 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10569 | | R300 | Resistor 6.80 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 10682 | |
| R236 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | | R301 | Resistor 820 Ω 1% 1/8 W 100PPM 1206 | 5322 116 82264 | |
| R237 | Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51002 | | R302 | Resistor 820 Ω 1% 1/8 W 100PPM 1206 | 5322 116 82264 | |
| R238 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | | R303 | Resistor 150 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51501 | |
| R239 | Resistor 1.00 MΩ 1% 1/8 W 100PPM 1206 | 4822 051 10105 | | R304 | Resistor 150 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51501 | |
| R240 | Resistor 560 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10561 | | R305 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R241 | Resistor 2.70 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 52702 | | R306 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R242 | Resistor 56 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10569 | | R307 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R243 | Resistor 56 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10569 | | R308 | Potentiometer 20 kΩ 10% 3323P-1-203-10 | 5322 101 11074 | |
| R244 | Resistor 56 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10569 | | R309 | Resistor 68.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 56803 | |
| R245 | Resistor 56 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10569 | | R310 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R246 | Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51002 | | R311 | Potentiometer 20 kΩ 10% 3323P-1-203-10 | 5322 101 11074 | |
| R247 | Resistor 68 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10689 | | R312 | Resistor 68.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 56803 | |
| R248 | Resistor 68 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10689 | | R313 | Resistor 3.30 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 53302 | |
| R249 | Resistor 15.0 kΩ 1% 1/8 W 100PPM 1206 | 5322 116 82261 | | R314 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | |
| R250 | Resistor 15.0 kΩ 1% 1/8 W 100PPM 1206 | 5322 116 82261 | | R316 | Resistor 3.30 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 53302 | |
| R251 | Resistor 560 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10561 | | R317 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | |
| R252 | Resistor 4.70 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 54702 | | R319 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R253 | Resistor 120 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10121 | | R320 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R254 | Resistor 47 Ω 1% 1/8 W 100PPM 1206 | 5322 116 80448 | | R321 | Resistor 10 kΩ 0.1% 1/4 W MPR24 | 5322 116 82868 | |
| R255 | Resistor 4.70 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 54702 | | R322 | Resistor 10 kΩ 0.1% 1/4 W MPR24 | 5322 116 82868 | |
| R256 | Resistor 270 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10271 | | R323 | Resistor 56 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10569 | |
| R257 | Resistor 150 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51501 | | R324 | Resistor 56 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10569 | |
| R258 | Resistor 1.50 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51502 | | R325 | Resistor 680 Ω 1% 1/8 W 100PPM 1206 | 4822 051 56801 | |
| R259 | Resistor 470 Ω 1% 1/8 W 100PPM 1206 | 4822 051 54701 | | R326 | Resistor 680 Ω 1% 1/8 W 100PPM 1206 | 4822 051 56801 | |
| R260 | Resistor 470 Ω 1% 1/8 W 100PPM 1206 | 4822 051 54701 | | R327 | Resistor 680 Ω 1% 1/8 W 100PPM 1206 | 4822 051 56801 | |
| R261 | Resistor 47 Ω 1% 1/8 W 100PPM 1206 | 5322 116 80448 | | R328 | Resistor 0 Ω RC-01 1206 | 4822 051 10008 | |
| R263 | Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51002 | | R329 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R264 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | | R330 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |

| Pos | Description | Part Number | ☆ |
|------|--|----------------|---|
| R331 | Potentiometer 20 kΩ 10% 3323P-1-203-10 | 5322 101 11074 | |
| R332 | Resistor 22.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 52203 | |
| R334 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R335 | Resistor 180.0 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10181 | |
| R336 | Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51002 | |
| R337 | Thermistor 16 Ω 20% 3.5A S236/16 | 5322 116 30457 | |
| R339 | Resistor 180.0 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10181 | |
| R340 | Resistor 56 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10569 | |
| R341 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | |
| R342 | Resistor 470 Ω 1% 1/8 W 100PPM 1206 | 4822 051 54701 | |
| R344 | Resistor 3.30 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 53302 | |
| R345 | Resistor 15.0 kΩ 1% 1/8 W 100PPM 1206 | 5322 116 82261 | |
| R346 | Resistor 470.0 kΩ 0.5% 1/8 W RC-03G 1206 | 5322 117 10858 | |
| R347 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R348 | Resistor 100 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51004 | |
| R349 | Resistor 33 Ω 5% 1.6W PR37 | 4822 116 51167 | |
| R350 | Resistor 15.0 kΩ 1% 1/8 W 100PPM 1206 | 5322 116 82261 | |
| R352 | Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51002 | |
| R353 | Resistor 0.22 Ω 5% SN14L2EJ | 5322 116 53071 | |
| R354 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | |
| R355 | Resistor 1.00 MΩ 1% 1/8 W 100PPM 1206 | 4822 051 10105 | |
| R356 | Resistor 100 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51004 | |
| R357 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R358 | Resistor 33 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 53303 | |
| R359 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R360 | Resistor 1.80 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 10182 | |
| R361 | Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51002 | |
| R365 | Resistor 560 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10561 | |
| R366 | Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51002 | |
| R367 | Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51002 | |
| R368 | Resistor 82 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10829 | |
| R369 | Resistor 56 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10569 | |
| R370 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | |
| R371 | Resistor 100 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51004 | |
| R372 | Resistor 390 Ω 1% 1/8 W 100PPM 1206 | 4822 051 53901 | |
| R373 | Resistor 560 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10561 | |
| R374 | Resistor 2.20 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 52202 | |
| R375 | Resistor 560 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10561 | |
| R377 | Resistor 4.70 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 54702 | |
| R378 | Resistor 4.70 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 54702 | |
| R379 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R380 | Resistor 4.70 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 54702 | |
| R381 | Potentiometer 1kΩ 20% 3323P-1-102 | 4822 101 10792 | |
| R382 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R383 | Resistor 330 Ω 1% 1/8 W 100PPM 1206 | 4822 051 53301 | |
| R384 | Potentiometer 20 kΩ 10% 3323P-1-203-10 | 5322 101 11074 | |
| R385 | Resistor 3.30 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 53302 | |
| R386 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | |
| R387 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | |
| R388 | Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51002 | |
| R402 | Resistor 47 Ω 1% 1/8 W 100PPM 1206 | 5322 116 80448 | |
| R403 | Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51002 | |
| R404 | Resistor 47 Ω 1% 1/8 W 100PPM 1206 | 5322 116 80448 | |
| R405 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | |
| R406 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R407 | Resistor 330 Ω 1% 1/8 W 100PPM 1206 | 4822 051 53301 | |
| R408 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | |

| Pos | Description | Part Number | ☆ |
|------|--|----------------|---|
| R409 | Resistor 100 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51004 | |
| R426 | Resistor 680 Ω 1% 1/8 W 100PPM 1206 | 4822 051 56801 | |
| R427 | Resistor 680 Ω 1% 1/8 W 100PPM 1206 | 4822 051 56801 | |
| R428 | Resistor 470.0 kΩ 0.5% 1/8 W RC-03G 1206 | 5322 117 10858 | |
| R429 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R430 | Resistor 47 Ω 1% 1/8 W 100PPM 1206 | 5322 116 80448 | |
| R431 | Resistor 27 Ω 1% 1/8 W 100PPM 1206 | 5322 116 82262 | |
| R432 | Resistor 82 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10829 | |
| R433 | Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51002 | |
| R435 | Resistor 82 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10829 | |
| R436 | Resistor 82 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10829 | |
| R437 | Resistor 270 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10271 | |
| R438 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R439 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R440 | Resistor 2.20 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 52202 | |
| R441 | Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51002 | |
| R442 | Resistor 1.80 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 10182 | |
| R443 | Resistor 3.90 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 53902 | |
| R444 | Resistor 47.0 kΩ 0.5% 1/8 W RC-03G 1206 | 5322 117 10857 | |
| R445 | Resistor 220 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 52204 | |
| R446 | Potentiometer 1kΩ 20% 3323P-1-102 | 4822 101 10792 | |
| R447 | Resistor 3.30 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 53302 | |
| R448 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R449 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R450 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R451 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R452 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R453 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R454 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R455 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R456 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R460 | Resistor 100 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51004 | |
| R461 | Resistor 100 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51004 | |
| R462 | Resistor 100 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51004 | |
| R463 | Resistor 100 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51004 | |
| R464 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R465 | Resistor 4.7 Ω 10% 1/4 W RC-01 1206 | 4833 051 10478 | |
| R466 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R467 | Resistor 100 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51004 | |
| R468 | Resistor 100 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51004 | |
| R469 | Resistor 10.0 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10109 | |
| R470 | Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51002 | |
| R471 | Resistor 2.7 Ω 5% 1/4 W RC-01 1206 | 4822 051 10278 | |
| R472 | Resistor 2.7 Ω 5% 1/4 W RC-01 1206 | 4822 051 10278 | |
| R473 | Resistor 2.7 Ω 5% 1/4 W RC-01 1206 | 4822 051 10278 | |
| R474 | Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51002 | |
| R475 | Resistor 10.0 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10109 | |
| R476 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | |
| R477 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | |
| R478 | Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51002 | |
| R479 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | |
| R480 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | |
| R481 | Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51002 | |
| R482 | Varistor 95V 95VRMS4.1J | 5322 116 21222 | |
| R483 | Resistor 4.70 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 54702 | |
| R484 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R485 | Resistor 22.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 52203 | |

| Pos | Description | Part Number | ☆ | Pos | Description | Part Number | ☆ |
|------|--|----------------|---|------|---------------------------------------|----------------|---|
| R486 | Resistor 8.20 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 10822 | | R562 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R488 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | | R563 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R489 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | | R564 | Thermistor 2.2 kΩ 3% 1/4 W NTC | 5322 116 30458 | |
| R490 | Resistor 33 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10339 | | R566 | Resistor 100 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51004 | |
| R491 | Resistor 2.20 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 52202 | | R567 | Resistor 100 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51004 | |
| R492 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | | R568 | Resistor 47 Ω 1% 1/8 W 100PPM 1206 | 5322 116 80448 | |
| R493 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | | R569 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | |
| R494 | Resistor 2.20 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 52202 | | R570 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R495 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | | R571 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R496 | Resistor 47 Ω 1% 1/8 W 100PPM 1206 | 5322 116 80448 | | R574 | Resistor 100 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51004 | |
| R497 | Resistor 33 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10339 | | R577 | Resistor 220.0 Ω 1% 1/8 W 100PPM 1206 | 4822 051 52201 | |
| R498 | Resistor 47 Ω 1% 1/8 W 100PPM 1206 | 5322 116 80448 | | R578 | Resistor 220.0 Ω 1% 1/8 W 100PPM 1206 | 4822 051 52201 | |
| R499 | Resistor 33 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10339 | | R579 | Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51002 | |
| R500 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | | R580 | Resistor 3.30 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 53302 | |
| R501 | Resistor 2.20 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 52202 | | R581 | Resistor 4.70 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 54702 | |
| R502 | Resistor 2.20 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 52202 | | R582 | Resistor 56 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10569 | |
| R503 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | | R583 | Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51002 | |
| R504 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | | R584 | Resistor 100 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51004 | |
| R508 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | | R585 | Resistor 33 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10339 | |
| R514 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | | R586 | Resistor 33 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10339 | |
| R515 | Resistor 33 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10339 | | R587 | Thermistor 2.2 kΩ 3% 1/4 W NTC | 5322 116 30458 | |
| R516 | Resistor 33 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10339 | | R588 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | |
| R517 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | | R589 | Resistor 1.00 MΩ 1% 1/8 W 100PPM 1206 | 4822 051 10105 | |
| R518 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | | R590 | Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51002 | |
| R519 | Resistor 33 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10339 | | R591 | Resistor 1.00 MΩ 1% 1/8 W 100PPM 1206 | 4822 051 10105 | |
| R520 | Resistor 33 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10339 | | R592 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R521 | Resistor 10.0 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10109 | | R593 | Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51002 | |
| R522 | Resistor 100 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51004 | | R594 | Resistor 820 Ω 1% 1/8 W 100PPM 1206 | 5322 116 82264 | |
| R523 | Resistor 33 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10339 | | R595 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | |
| R524 | Resistor 2.20 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 52202 | | R596 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R525 | Resistor 220.0 Ω 1% 1/8 W 100PPM 1206 | 4822 051 52201 | | R597 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R527 | Resistor 33 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10339 | | R598 | Resistor 47 Ω 1% 1/8 W 100PPM 1206 | 5322 116 80448 | |
| R528 | Resistor 47 Ω 1% 1/8 W 100PPM 1206 | 5322 116 80448 | | R599 | Resistor 2.20 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 52202 | |
| R529 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | | R600 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | |
| R530 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | | R601 | Resistor 33 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10339 | |
| R531 | Resistor 47 Ω 1% 1/8 W 100PPM 1206 | 5322 116 80448 | | R602 | Resistor 100 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51004 | |
| R535 | Resistor 47 Ω 1% 1/8 W 100PPM 1206 | 5322 116 80448 | | R603 | Resistor 100 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51004 | |
| R536 | Resistor 47 Ω 1% 1/8 W 100PPM 1206 | 5322 116 80448 | | R604 | Resistor 33 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10339 | |
| R537 | Resistor 120 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10121 | | R605 | Resistor 100 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51004 | |
| R538 | Resistor 33 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10339 | | R606 | Resistor 100 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51004 | |
| R544 | Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51002 | | R607 | Resistor 56 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10569 | |
| R545 | Resistor 47.0 kΩ 0.5% 1/8 W RC-03G 1206 | 5322 117 10857 | | R608 | Resistor 56 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10569 | |
| R546 | Resistor 33 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10339 | | R609 | Resistor 56 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10569 | |
| R547 | Resistor 390 Ω 1% 1/8 W 100PPM 1206 | 4822 051 53901 | | R610 | Resistor 56 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10569 | |
| R548 | Resistor 470.0 kΩ 0.5% 1/8 W RC-03G 1206 | 5322 117 10858 | | R611 | Resistor 56 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10569 | |
| R549 | Resistor 470.0 kΩ 0.5% 1/8 W RC-03G 1206 | 5322 117 10858 | | R612 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | |
| R550 | Resistor 18.0 kΩ 1% 1/8 W 100PPM 1206 | 5322 117 10034 | | R613 | Resistor 56 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10569 | |
| R551 | Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 51003 | | R614 | Resistor 56 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10569 | |
| R552 | Resistor 2.20 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 52202 | | R615 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | |
| R553 | Resistor 2.20 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 52202 | | R616 | Resistor 56 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10569 | |
| R555 | Resistor 10 MΩ 10% 1/4 W RC-01 1206 | 4822 051 10106 | | T1 | Transformer PM6680-Ser New PS | 5322 148 20035 | P |
| R556 | Resistor 47.0 kΩ 0.5% 1/8 W RC-03G 1206 | 5322 117 10857 | | U1 | IC CA3140M SO8 | 4822 209 62796 | |
| R557 | Resistor 4.70 kΩ 1% 1/8 W 100PPM 1206 | 4822 051 54702 | | U2 | IC CA3140M SO8 | 4822 209 62796 | |
| R558 | Resistor 10.0 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10109 | | U02 | IC PC74HC574T SO20 | 4822 209 60451 | |
| R559 | Resistor 47 Ω 1% 1/8 W 100PPM 1206 | 5322 116 80448 | | U3 | IC-KOMP AD96687BQ DUAL DIL16 | 5322 209 33098 | |
| R560 | Resistor 100 Ω 1% 1/8 W 100PPM 1206 | 4822 051 51001 | | U5 | IC-REG TL431C-LP TO92 | 4822 209 81397 | |
| R561 | Resistor 270 Ω 1% 1/8 W 100PPM 1206 | 4822 051 10271 | | U6 | IC-MIKROP N80C196KC16 SMD | 5322 209 33105 | |

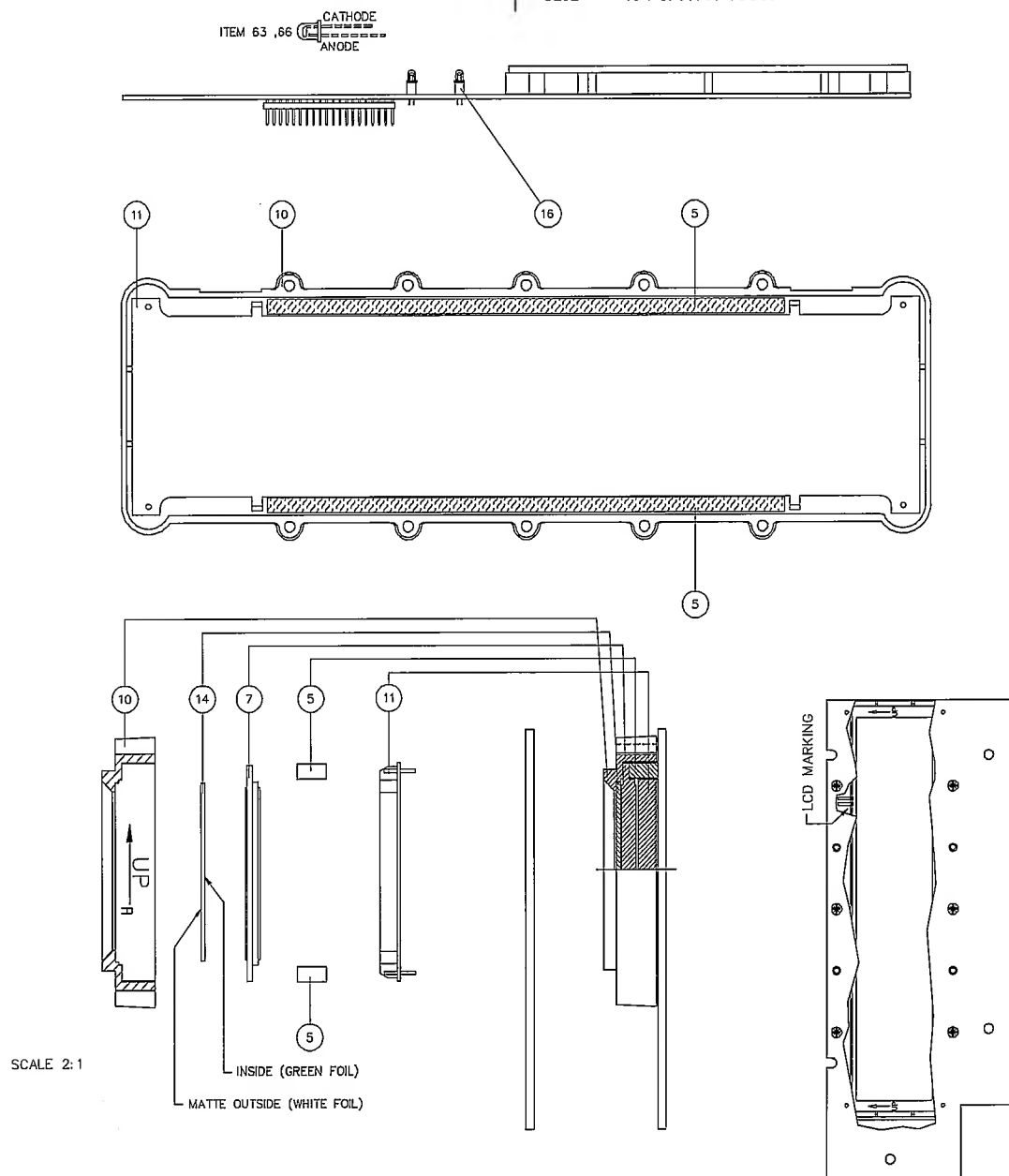
| Pos | Description | Part Number | ☆ |
|-----|-----------------------------------|----------------|---|
| U6 | IC socket 68 POL 821574-1 F PLCC | 5322 255 40677 | |
| U7 | IC 1.50 A LM317T TO-220 | 4822 209 80591 | |
| U8 | IC TL7770-50W | 5322 209 30397 | |
| U9 | IC 64 KBIT TC5564PL-1 8KX8 | 5322 209 62104 | |
| U10 | IC-RAM CMOS TC55328P-35 256kB SMD | 5322 209 33099 | |
| U11 | IC-RAM CMOS TC55328P-35 256kB SMD | 5322 209 33099 | |
| U12 | IC-RAM CMOS TC55328P-35 256kB SMD | 5322 209 33099 | |
| U13 | IC-RAM CMOS TC55328P-35 256kB SMD | 5322 209 33099 | |
| U14 | IC-CMOS 74AC573 SO20 SMD | 5322 209 33147 | |
| U15 | IC-CMOS 74AC573 SO20 SMD | 5322 209 33147 | |
| U16 | IC socket 32 POL 644 018-3 | 5322 255 40921 | |
| U16 | IC-PROM PM6681 AM27H010-70DC | 5322 209 52494 | * |
| U17 | IC socket 32 POL 644 018-3 | 5322 255 40921 | |
| U17 | IC-PROM PM6681 AM27H010-70DC | 5322 209 52494 | * |
| U18 | IC PC74HC574T SO20 | 4822 209 60451 | |
| U19 | IC PC74HC574T SO20 | 4822 209 60451 | |
| U20 | IC-CMOS 74AC573 SO20 SMD | 5322 209 33147 | |
| U21 | IC-CMOS 74AC11021 AND4 SO14 SMD | 5322 209 33175 | |
| U22 | IC-CMOS 74AC11021 AND4 SO14 SMD | 5322 209 33175 | |
| U23 | IC-CMOS 74AC11021 AND4 SO14 SMD | 5322 209 33175 | |
| U24 | IC-CMOS 74AC11020 NAND4 SO14 SMD | 5322 209 33174 | |
| U25 | IC-CMOS 74AC11020 NAND4 SO14 SMD | 5322 209 33174 | |
| U26 | IC-CMOS 74AC08D 4XAND2 SO14 SMD | 5322 209 33102 | |
| U27 | IC-CMOS 74AC08D 4XAND2 SO14 SMD | 5322 209 33102 | |
| U28 | IC-CMOS 74AC86D 4XEXOR2 SO14 SMD | 5322 209 33103 | |
| U29 | IC-CMOS 74AC11027 NOR3 SO16 SMD | 5322 209 33176 | |
| U30 | IC-CMOS 74AC11027 NOR3 SO16 SMD | 5322 209 33176 | |
| U31 | IC-CMOS 74AC02D 4XNOR2 SO14 SMD | 5322 209 33101 | |
| U32 | IC-CMOS 74AC32D 4XOR2 SO14 SMD | 5322 209 33104 | |
| U33 | IC-CMOS 74AC32D 4XOR2 SO14 SMD | 5322 209 33104 | |
| U34 | IC-CMOS 74AC32D 4XOR2 SO14 SMD | 5322 209 33104 | |
| U35 | IC-CMOS 74AC32D 4XOR2 SO14 SMD | 5322 209 33104 | |
| U36 | IC PC74HC138T SO16 | 5322 209 73178 | |
| U39 | IC-CMOS 74AC11191 BIN-C SO20 SMD | 5322 209 33177 | |
| U41 | IC-CMOS 74AC11191 BIN-C SO20 SMD | 5322 209 33177 | |
| U44 | IC-CMOS 74AC573 SO20 SMD | 5322 209 33147 | |
| U45 | IC-CMOS 74AC02D 4XNOR2 SO14 SMD | 5322 209 33101 | |
| U46 | IC-CMOS 74AC02D 4XNOR2 SO14 SMD | 5322 209 33101 | |
| U47 | IC-CMOS 74AC02D 4XNOR2 SO14 SMD | 5322 209 33101 | |
| U48 | IC-CMOS 74AC02D 4XNOR2 SO14 SMD | 5322 209 33101 | |
| U49 | IC-CMOS 74AC02D 4XNOR2 SO14 SMD | 5322 209 33101 | |
| U50 | IC-CMOS 74AC02D 4XNOR2 SO14 SMD | 5322 209 33101 | |
| U51 | IC-CMOS 74AC02D 4XNOR2 SO14 SMD | 5322 209 33101 | |
| U53 | IC-CMOS 74AC11191 BIN-C SO20 SMD | 5322 209 33177 | |
| U54 | IC-CMOS 74AC11027 NOR3 SO16 SMD | 5322 209 33176 | |
| U55 | IC PC74HC574T SO20 | 4822 209 60451 | |
| U56 | IC-LSI CMOS PM6680-SER | 5322 209 62844 | R |
| U56 | IC socket 44 POL PLCC | 5322 255 41315 | |
| U57 | IC 1.50 A LM317T TO-220 | 4822 209 80591 | |
| U58 | IC-LSI BIPOL PM6681 | 5322 209 33097 | R |
| U58 | IC socket 68 POL 821574-1 F PLCC | 5322 255 40677 | |
| U59 | IC 75uV LÄG OFFSET DIL-8 | 5322 209 62119 | |
| U60 | IC PC74HC4353T SO20 | 4822 209 62805 | |
| U61 | IC 75uV LÄG OFFSET DIL-8 | 5322 209 62119 | |
| U62 | IC 75uV LÄG OFFSET DIL-8 | 5322 209 62119 | |
| U63 | IC-DAC 12BIT AD7545AKN DIL20 | 5322 209 62107 | |
| U64 | IC-DAC 12BIT AD7545AKN DIL20 | 5322 209 62107 | |
| U65 | IC 75uV LÄG OFFSET DIL-8 | 5322 209 62119 | |
| U66 | IC 75uV LÄG OFFSET DIL-8 | 5322 209 62119 | |

| Pos | Description | Part Number | ☆ |
|-----|------------------------------------|----------------|---|
| U67 | IC NE532D DUAL SO-8 | 5322 209 71553 | |
| U69 | Heat sink 16\$KW TO220 | 5322 255 41313 | P |
| U69 | IC 12 V UA7812UC 1A TO-220 | 5322 209 86176 | |
| U70 | IC 1.50 A LM317T TO-220 | 4822 209 80591 | |
| U71 | IC-REG TL431C-LP TO92 | 4822 209 81397 | |
| U72 | IC 75uV LÄG OFFSET DIL-8 | 5322 209 62119 | |
| U73 | Heat sink 16\$KW TO220 | 5322 255 41313 | P |
| U73 | IC 1.50 A LM337T TO-220 | 5322 209 81236 | |
| U74 | IC-REG TL431C-LP TO92 | 4822 209 81397 | |
| U75 | IC CA3140M SO8 | 4822 209 62796 | |
| U77 | IC NE532D DUAL SO-8 | 5322 209 71553 | |
| U78 | IC P8291A TALK/LISTEN | 5322 209 81264 | |
| U79 | IC SN75161AN | 5322 209 81842 | |
| U80 | IC SN75160AN | 5322 209 81807 | |
| U82 | IC-CMOS 74AC11021 AND4 SO14 SMD | 5322 209 33175 | |
| U84 | IC-DIG ECL 100304PC PDIP24 | 5322 209 33638 | |
| U85 | IC-DIG ECL 100331QC PCC28 | 5322 209 33604 | |
| U86 | IC-REF 2.50 V MC1403U DIL-8 | 5322 209 82864 | |
| U87 | IC-CMOS 74AC11020 NAND4 SO14 SMD | 5322 209 33174 | |
| U88 | IC-BUS TRANSEIV 75ALS176D SO-8 SMD | 5322 209 33171 | |
| U90 | Optocoupler CNX82A SEMKO SOT231 | 4822 130 10025 | |
| U91 | IC-ANA SMPS CTR UC3842AD SO14 | 5322 209 33169 | |
| U92 | IC-REF 2.5V TL431I-D SO8 | 5322 209 62422 | |
| U93 | IC-CMOS 74AC02D 4XNOR2 SO14 SMD | 5322 209 33101 | |
| U94 | IC-CMOS 74AC86D 4XEXOR2 SO14 SMD | 5322 209 33103 | |
| U95 | IC NE532D DUAL SO-8 | 5322 209 71553 | |
| U97 | IC- 14C88M SO14 | 5322 209 33108 | |
| U98 | IC-CMOS 74AC08D 4XAND2 SO14 SMD | 5322 209 33102 | |
| U99 | IC NE532D DUAL SO-8 | 5322 209 71553 | |
| V1 | Transistor BF513 .03A20V SOT23 | 4822 130 60686 | |
| V2 | Transistor BF513 .03A20V SOT23 | 4822 130 60686 | |
| V3 | Transistor BFS17 .05A 15V SOT23 | 5322 130 40781 | |
| V4 | Transistor BFS17 .05A 15V SOT23 | 5322 130 40781 | |
| V8 | Transistor BFS17 .05A 15V SOT23 | 5322 130 40781 | |
| V9 | Transistor BSR12 0.1A 15V SOT23 | 5322 130 44743 | |
| V12 | Transistor BSR12 0.1A 15V SOT23 | 5322 130 44743 | |
| V14 | Transistor BSR12 0.1A 15V SOT23 | 5322 130 44743 | |
| V15 | Transistor BC847B .1A45V SOT23 | 4822 130 60511 | |
| V16 | Transistor BC857B .1A45V SOT23 | 5322 130 60508 | |
| V17 | Transistor BC857B .1A45V SOT23 | 5322 130 60508 | |
| V18 | Transistor BC369 1A 20V TO92 | 5322 130 44593 | |
| V19 | Transistor BFS17 .05A 15V SOT23 | 5322 130 40781 | |
| V20 | Transistor BFS17 .05A 15V SOT23 | 5322 130 40781 | |
| V21 | Transistor BF513 .03A20V SOT23 | 4822 130 60686 | |
| V22 | Transistor 25 MA BFR92A 20V SOT23 | 5322 130 60647 | |
| V23 | Transistor BFG97 0.1A 15V SO223 | 4822 130 63069 | |
| V25 | Transistor 25 MA BFR92A 20V SOT23 | 5322 130 60647 | |
| V26 | Transistor BFG97 0.1A 15V SO223 | 4822 130 63069 | |
| V27 | Transistor BFS17 .05A 15V SOT23 | 5322 130 40781 | |
| V28 | Transistor 25 MA BFR92A 20V SOT23 | 5322 130 60647 | |
| V29 | Transistor BFG97 0.1A 15V SO223 | 4822 130 63069 | |
| V31 | Transistor 25 MA BFR92A 20V SOT23 | 5322 130 60647 | |
| V32 | Transistor BFG97 0.1A 15V SO223 | 4822 130 63069 | |
| V33 | Transistor BFS17 .05A 15V SOT23 | 5322 130 40781 | |
| V40 | Transistor BFS17 .05A 15V SOT23 | 5322 130 40781 | |
| V41 | Transistor BFS17 .05A 15V SOT23 | 5322 130 40781 | |
| V42 | Transistor BFS17 .05A 15V SOT23 | 5322 130 40781 | |
| V43 | Transistor BSV52 0.1A 12V SOT23 | 5322 130 44336 | |
| V44 | Transistor BC847B .1A45V SOT23 | 4822 130 60511 | |

| Pos | Description | Part Number | ☆ | Pos | Description | Part Number | ☆ |
|-----|--------------------------------------|----------------|---|-----|--------------------------------------|----------------|---|
| V45 | Transistor BC847B .1A45V SOT23 | 4822 130 60511 | | V59 | Transistor 0.50 A BC817-25 45V SOT23 | 4822 130 42804 | |
| V46 | Transistor BC847B .1A45V SOT23 | 4822 130 60511 | | V60 | Transistor 0.50 A BC817-25 45V SOT23 | 4822 130 42804 | |
| V47 | Transistor BC847B .1A45V SOT23 | 4822 130 60511 | | V61 | Transistor BC847B .1A45V SOT23 | 4822 130 60511 | |
| V48 | Transistor BC847B .1A45V SOT23 | 4822 130 60511 | | V62 | Transistor BCP51 1.5A 45V SOT223 | 5322 130 62639 | |
| V49 | Transistor BC847B .1A45V SOT23 | 4822 130 60511 | | V63 | Transistor 0.50 A BC817-25 45V SOT23 | 4822 130 42804 | |
| V50 | Transistor BC847B .1A45V SOT23 | 4822 130 60511 | | V64 | Transistor 0.50 A BC807-25 45V SOT23 | 5322 130 60845 | |
| V51 | Transistor BC847B .1A45V SOT23 | 4822 130 60511 | | V65 | Transistor BC847B .1A45V SOT23 | 4822 130 60511 | |
| V52 | Transistor BC847B .1A45V SOT23 | 4822 130 60511 | | V66 | Transistor BC857B .1A45V SOT23 | 5322 130 60508 | |
| V53 | Transistor BC847B .1A45V SOT23 | 4822 130 60511 | | V67 | Transistor BFS17 .05A 15V SOT23 | 5322 130 40781 | |
| V54 | Transistor BC847B .1A45V SOT23 | 4822 130 60511 | | V68 | Transistor BFS17 .05A 15V SOT23 | 5322 130 40781 | |
| V55 | Heat sink 13.5\$/KW TO220 | 5322 255 41314 | P | V69 | Transistor BC847B .1A45V SOT23 | 4822 130 60511 | |
| V55 | Clip ELFA 2201 | 5322 405 91687 | P | V70 | Transistor BC847B .1A45V SOT23 | 4822 130 60511 | |
| V55 | Transi-pow MOS 2A BUK446-800A SOT186 | 5322 130 63535 | | V71 | Transistor BC847B .1A45V SOT23 | 4822 130 60511 | |
| V56 | Transistor 0.50 A BC807-25 45V SOT23 | 5322 130 60845 | | X2 | Connector 3 POL F095 single row | 5322 290 60445 | |
| V57 | Transistor 0.50 A BC817-25 45V SOT23 | 4822 130 42804 | | X4 | Connector 3 POL F095 single row | 5322 290 60445 | |
| V58 | Transistor 0.50 A BC817-25 45V SOT23 | 4822 130 42804 | | | | | |

Front board

| Pos | Description | Part Number | ☆ | Pos | Description | Part Number | ☆ |
|------|----------------------------------|----------------|---|-------|--|----------------|---|
| | PC-B 2 assy | 5322 218 70109 | P | D203 | LED 3mm Yellow 590nm 4-8MCD/10 mA | 4822 130 30953 | R |
| 5 | Zebra strip | 5322 267 70294 | R | D204 | LED 3mm Yellow 590nm 4-8MCD/10 mA | 4822 130 30953 | R |
| 7 | LCD display | 5322 130 90889 | R | DL100 | Backlight | 5322 130 82201 | R |
| 10 | LCD rim | 5322 464 90667 | R | E201 | LCD display | 5322 130 90889 | R |
| 11 | Backlight | 5322 130 82201 | R | P204 | Connector 40 POL TMH-120-01-L-DW | 5322 265 51295 | |
| 14 | Window LCD | 5322 381 11136 | P | R201 | Resistor 220 k Ω 1% 1/8 W 100PPM 1206 | 4822 051 52204 | |
| 16 | LED spacer | 5322 255 41228 | | R202 | Resistor 390 Ω 1% 1/8 W 100PPM 1206 | 4822 051 53901 | |
| 32 | Screw RX-PT Z 2-28X8 FZB | 4822 502 30081 | P | R203 | Resistor 390 Ω 1% 1/8 W 100PPM 1206 | 4822 051 53901 | |
| C201 | Capacitor 10 nF 20% 50V X7R 0805 | 5322 122 34098 | | R204 | Resistor 4.7 Ω 10% 1/4 W RC-01 1206 | 4833 051 10478 | |
| C202 | Capacitor 10 nF 20% 50V X7R 0805 | 5322 122 34098 | | R205 | Resistor 4.7 Ω 10% 1/4 W RC-01 1206 | 4833 051 10478 | |
| D201 | LED 3mm HLMP-K150 Red 1 mA | 5322 130 81921 | | U201 | IC PCF8576T VSO56 | 5322 209 11129 | |
| D202 | LED 3mm Yellow 590nm 4-8MCD/10mA | 4822 130 30953 | R | U202 | IC PCF8576T VSO56 | 5322 209 11129 | |



PM 9621

| Pos | Description | Part Number | ☆ | Pos | Description | Part Number | ☆ |
|------|---------------------------------------|----------------|---|-----|--|----------------|---|
| | Cable assy, | 5322 321 22313 | | L7 | Choke, 0.1H, 10% MLF3216DR10K | 5322 157 52986 | |
| | Shield cover, | 5322 447 91673 | P | L8 | Choke, 0.1H, 10% MLF3216DR10K | 5322 157 52986 | |
| | Shield, | 5322 447 91672 | P | L9 | Choke, 0.1H, 10% MLF3216DR10K | 5322 157 52986 | |
| BU1 | Connector, R 114426 SMB | 5322 267 60199 | | R1 | Resistor, 470 Ω , 1% 1/8W 100PPM 1206 | 5322 116 80444 | |
| BU7 | Connector, 16pin, F095 90deg d. Row | 5322 267 74032 | | R2 | Resistor, 470 Ω , 1% 1/8W 100PPM 1206 | 5322 116 80444 | |
| C1 | Capacitor, 100 pF, 5% 50V NP0 0805 | 5322 122 32531 | | R3 | Resistor, 470 Ω , 1% 1/8W 100PPM 1206 | 5322 116 80444 | |
| C2 | Capacitor, 1 nF, 20% 50V X7R 0805 | 5322 122 34123 | | R4 | Resistor, 22 Ω , 1% 1/8W 100PPM 1206 | 4822 051 10229 | |
| C3 | Capacitor, 1 nF, 20% 50V X7R 0805 | 5322 122 34123 | | R5 | Resistor, 22 Ω , 1% 1/8W 100PPM 1206 | 4822 051 10229 | |
| C4 | Capacitor, 10 nF, 20% 50V X7R 0805 | 5322 122 34098 | | R6 | Resistor, 22 Ω , 1% 1/8W 100PPM 1206 | 4822 051 10229 | |
| C5 | Capacitor, 1 nF, 20% 50V X7R 0805 | 5322 122 34123 | | R7 | Resistor, 22 Ω , 1% 1/8W 100PPM 1206 | 4822 051 10229 | |
| C6 | Capacitor, 1 nF, 20% 50V X7R 0805 | 5322 122 34123 | | R8 | Resistor, 22 Ω , 1% 1/8W 100PPM 1206 | 4822 051 10229 | |
| C7 | Capacitor, 47 pF, 5% 50V NP0 0805 | 5322 122 32452 | | R9 | Resistor, 22 Ω , 1% 1/8W 100PPM 1206 | 4822 051 10229 | |
| C8 | Capacitor, 1 nF, 20% 50V X7R 0805 | 5322 122 34123 | | R10 | Resistor, 270 Ω , 1% 1/8W 100PPM 1206 | 4822 051 10271 | |
| C10 | Capacitor, 4.7 pF, 5% 50V NP0 0805 | 5322 122 32287 | | R11 | Resistor, 330 Ω , 1% 1/8W 100PPM 1206 | 5322 116 80438 | |
| C11 | Capacitor, 1 nF, 20% 50V X7R 0805 | 5322 122 34123 | | R12 | Resistor, 330 Ω , 1% 1/8W 100PPM 1206 | 5322 116 80438 | |
| C12 | Capacitor, 1 nF, 20% 50V X7R 0805 | 5322 122 34123 | | R13 | Resistor, 8.2 Ω , 10% 1/4W RC-01 1206 | 4822 051 10828 | |
| C13 | Capacitor, 15 pF, 5% 50V NP0 0805 | 5322 122 33869 | | R14 | Resistor, 150 Ω , 1% 1/8W 100PPM 1206 | 5322 116 80431 | |
| C14 | Capacitor, 1 nF, 20% 50V X7R 0805 | 5322 122 34123 | | R15 | Resistor, 8.2 Ω , 10% 1/4W RC-01 1206 | 4822 051 10828 | |
| C16 | Capacitor, 1 pF, 5% 50V NP0 0805 | 5322 122 32447 | | R16 | Resistor, 220 Ω , 1% 1/8W 100PPM 1206 | 5322 116 80433 | |
| C17 | Capacitor, 1 nF, 20% 50V X7R 0805 | 5322 122 34123 | | R19 | Resistor, 33 Ω , 1% 1/8W 100PPM 1206 | 4822 051 10339 | |
| C18 | Capacitor, 10 nF, 20% 50V X7R 0805 | 5322 122 34098 | | R20 | Resistor, 10 Ω , 1% 1/8W 100PPM 1206 | 4822 051 10109 | |
| C19 | Capacitor, 10 nF, 20% 50V X7R 0805 | 5322 122 34098 | | R21 | Resistor, 47 Ω , 1% 1/8W 100PPM 1206 | 5322 116 80448 | |
| C20 | Capacitor, 10 nF, 20% 50V X7R 0805 | 5322 122 34098 | | R22 | Resistor, 47 Ω , 1% 1/8W 100PPM 1206 | 5322 116 80448 | |
| C21 | Capacitor, 10 nF, 20% 50V X7R 0805 | 5322 122 34098 | | R24 | Resistor, 180 Ω , 1% 1/8W 100PPM 1206 | 4822 051 10181 | |
| C22 | Capacitor, 10 nF, 20% 50V X7R 0805 | 5322 122 34098 | | R25 | Resistor, 2.7 k Ω , 1% 1/8W 100PPM 1206 | 5322 116 80437 | |
| C23 | Capacitor, 15 F, 20%6.3V 6.0X3.2 mold | 5322 124 10684 | | R26 | Resistor, 47 k Ω , 1% 1/8W 100PPM 1206 | 5322 116 80446 | |
| C24 | Capacitor, 1 nF, 20% 50V X7R 0805 | 5322 122 34123 | | R27 | Resistor, 2.2 k Ω , 1% 1/8W 100PPM 1206 | 5322 116 80434 | |
| C25 | Capacitor, 10 nF, 20% 50V X7R 0805 | 5322 122 34098 | | R28 | Resistor, 270 Ω , 1% 1/8W 100PPM 1206 | 4822 051 10271 | |
| C26 | Capacitor, 10 nF, 20% 50V X7R 0805 | 5322 122 34098 | | R29 | Resistor, 330 Ω , 1% 1/8W 100PPM 1206 | 5322 116 80438 | |
| C27 | Capacitor, 10 nF, 20% 50V X7R 0805 | 5322 122 34098 | | R30 | Potentiometer, 1 k Ω , 10% 72X | 5322 101 14299 | |
| C31 | Capacitor, 1 pF, 5% 50V NP0 0805 | 5322 122 32447 | | R31 | Resistor, 47 k Ω , 1% 1/8W 100PPM 1206 | 5322 116 80446 | |
| C32 | Capacitor, 3.3 pF, 5% 50V NP0 0805 | 5322 122 32286 | | R32 | Resistor, 4.7 k Ω , 1% 1/8W 100PPM 1206 | 5322 116 80445 | |
| C34 | Capacitor, 3.3 pF, 5% 50V NP0 0805 | 5322 122 32286 | | R33 | Resistor, 3.3 k Ω , 1% 1/8W 100PPM 1206 | 5322 116 80439 | |
| C35 | Capacitor, 22 pF, 5% 50V NP0 0805 | 5322 122 32658 | | R35 | Resistor, 220 k Ω , 1% 1/8W 100PPM 1206 | 5322 116 80436 | |
| C36 | Capacitor, 10 nF, 20% 50V X7R 0805 | 5322 122 34098 | | R38 | Resistor, 1 k Ω , 1% 1/8W 100PPM 1206 | 5322 116 80427 | |
| C37 | Capacitor, 2.2 pF, 5% 50V NP0 0805 | 5322 122 33063 | | R39 | Resistor, 470 k Ω , 1% 1/8W 100PPM 1206 | 5322 116 80447 | |
| C38 | Capacitor, 10 nF, 20% 50V X7R 0805 | 5322 122 34098 | | R40 | Resistor, 33 k Ω , 1% 1/8W 100PPM 1206 | 5322 116 80441 | |
| C39 | Capacitor, 1 nF, 20% 50V X7R 0805 | 5322 122 34123 | | R41 | Resistor, 560 Ω , 1% 1/8W 100PPM 1206 | 4822 051 10561 | |
| C40 | Capacitor, 1 nF, 20% 50V X7R 0805 | 5322 122 34123 | | R42 | Resistor, 27 Ω , 1% 1/8W 100PPM 1206 | 5322 116 82262 | |
| GR3 | Diode, 0.03A, BAT17 SOT23 | 5322 130 31544 | | R43 | Resistor, 1.8 k Ω , 1% 1/8W 100PPM 1206 | 4822 051 10182 | |
| GR4 | Diode, 0.03A, BAT17 SOT23 | 5322 130 31544 | | R44 | Resistor, 3.3 k Ω , 1% 1/8W 100PPM 1206 | 5322 116 80439 | |
| GR5 | Diode, 0.03A, BAT17 SOT23 | 5322 130 31544 | | R47 | Resistor, 470 Ω , 1% 1/8W 100PPM 1206 | 5322 116 80444 | |
| GR6 | Diode, 0.03A, BAT17 SOT23 | 5322 130 31544 | | R48 | Resistor, 82 Ω , 1% 1/8W 100PPM 1206 | 4822 051 10829 | |
| GR7 | Diode, 0.03A, BAT17 SOT23 | 5322 130 31544 | | R52 | Resistor, 47 k Ω , 1% 1/8W 100PPM 1206 | 5322 116 80446 | |
| GR8 | Diode, 0.1A, BAV99 SOT23 | 5322 130 34337 | | R53 | Resistor, 10 k Ω , 1% 1/8W 100PPM 1206 | 5322 116 80428 | |
| GR9 | Diode, 0.03A, BAT17 SOT23 | 5322 130 31544 | | R55 | Resistor, 33 Ω , 1% 1/8W 100PPM 1206 | 4822 051 10339 | |
| GR11 | Diode, BAR 16-1 SOT23 | 5322 130 80246 | | R56 | Resistor, 22 Ω , 1% 1/8W 100PPM 1206 | 4822 051 10229 | |
| GR15 | Diode, 0.03A, BAT17 SOT23 | 5322 130 31544 | | R57 | Resistor, 100 Ω , 1% 1/8W 100PPM 1206 | 5322 116 80426 | |
| GR16 | Diode, 0.1A, BAV99 SOT23 | 5322 130 34337 | | R58 | Resistor, 1 k Ω , 1% 1/8W 100PPM 1206 | 5322 116 80427 | |
| GR17 | Diode, 0.1A, BAV99 SOT23 | 5322 130 34337 | | R59 | Resistor, 1 k Ω , 1% 1/8W 100PPM 1206 | 5322 116 80427 | |
| GR18 | Diode, 0.1A, BAV99 SOT23 | 5322 130 34337 | | R60 | Resistor, 120 Ω , 1% 1/8W 100PPM 1206 | 4822 051 10121 | |
| IC1 | IC, 1.2 GHz, UPC1652G SO-8 VAR | 5322 209 71557 | | R61 | Resistor, 120 Ω , 1% 1/8W 100PPM 1206 | 4822 051 10121 | |
| IC2 | IC, 1.3 GHz, U833BS | 5322 209 61399 | | R62 | Resistor, 330 Ω , 1% 1/8W 100PPM 1206 | 5322 116 80438 | |
| IC3 | IC, NE532D DUAL SO-8 | 5322 209 71553 | | | | | |
| L1 | Choke, 0.1H, 10% MLF3216DR10K | 5322 157 52986 | | | | | |

| Pos | Description | Part Number | ☆ |
|------------|--|--------------------|---|
| R63 | Resistor, 100 Ω , 1% 1/8W 100PPM 1206 | 5322 116 80426 | |
| R64 | Resistor, 470 k Ω , 1% 1/8W 100PPM 1206 | 5322 116 80447 | |
| R65 | Resistor, 220 k Ω , 1% 1/8W 100PPM 1206 | 5322 116 80436 | |
| R66 | Resistor, 0 Ω , RC-01 1206 | 4822 051 10008 | |
| TP3 | Flat Pin, 2.8mm, E184/8 lesa sn band | 5322 290 34064 | |
| TP4 | Flat Pin, 2.8mm, E184/8 lesa sn band | 5322 290 34064 | |
| TS1 | Transistor, BFQ67 SOT23 | 5322 130 42567 | |
| TS2 | Transistor, BFQ67 SOT23 | 5322 130 42567 | |

| Pos | Description | Part Number | ☆ |
|------------|----------------------------------|--------------------|---|
| TS3 | Transistor, BC847B .1A45V SOT23 | 4822 130 60511 | |
| TS4 | Transistor, BC847B .1A45V SOT23 | 4822 130 60511 | |
| TS5 | Transistor, BFS17 .05A 15V SOT23 | 5322 130 40781 | |
| TS6 | Transistor, BFS17 .05A 15V SOT23 | 5322 130 40781 | |
| TS7 | Transistor, BFS17 .05A 15V SOT23 | 5322 130 40781 | |
| TS8 | Transistor, BFT92 25MA 15V SOT23 | 5322 130 44711 | |
| TS9 | Transistor, BC847B .1A45V SOT23 | 4822 130 60511 | |
| TS10 | Transistor, BC847B .1A45V SOT23 | 4822 130 60511 | |

PM 9678B

| Pos | Description | Part Number | ☆ |
|-----|---------------------------------------|----------------|---|
| | Screw, MRT-KOMBI 3X06 STFZ | 4822 502 11658 | P |
| | Spring Washer, KBA 3.2 ST FZ DIN137 | 4822 530 80173 | P |
| BU1 | Connector, 10 pin, 22-14-2104 4455-BC | 5322 267 50336 | |
| C1 | Capacitor, 65 pF, 5,5-65pF 100V | 4822 125 50017 | |

| Pos | Description | Part Number | ☆ |
|-----|-----------------------------------|----------------|---|
| C2 | Capacitor, 15 F, 20% 16V SOLID AL | 4822 124 20977 | |
| KT1 | Oscillator, 10 MHz, TCXO | 5322 216 94047 | R |
| R1 | Resistor, 147, 1% 1/2 W MRS25 | 4822 050 21471 | |
| TS1 | Transistor, BF245C.025A 30V TO92 | 4822 130 41065 | |

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Chapter 8

Schematic Diagrams

How to Read the Diagrams

This chapter contains circuit diagrams and component layout information.

Each diagram contains a list of the ICs used. These lists indicate the connections that are not shown in the diagram, such as GND and supply voltages.

Signals

The signals in the counter are named after what they do, e.g. LEAD-EDGE is used as control current to the leading edge circuits.

Two different types of arrows are used to mark references for continued connection somewhere else in the diagram.



This arrow is used if the reference is directed to a point located on the same page.



This arrow is used if the reference is directed to a point located on another page. The example means that the point is on sheet 1, coordinate A1.

Colored Areas

The coloured areas in the diagrams represent following functions:



= Integrated circuits



= Trim points, test points or jumpers



= Connectors

Circuit Symbols

The diagrams are computer drawn. The symbols conform to IEC standards. These symbols are designed to be logical and easy to read.

The component number is written above the symbol.

Inside the symbol at the top is an abbreviated description of the circuit's function.

Pin numbers are written outside the symbol and, if the circuit is complex, the pin functions are written inside.

A small circle on a pin indicates that the input/output inverts the signal.

The component name is written below the symbol.

The signal flow through the circuit is always from left to right.

Resistors, Capacitors, Diodes, Transistors and Other Components.

These components are similar to the old-fashioned, hand-drawn symbols. They have their component number above and their value or component name below.

A resistor contained in a resistor network has a frame drawn around it and one of the pin numbers is written to the left or below it.

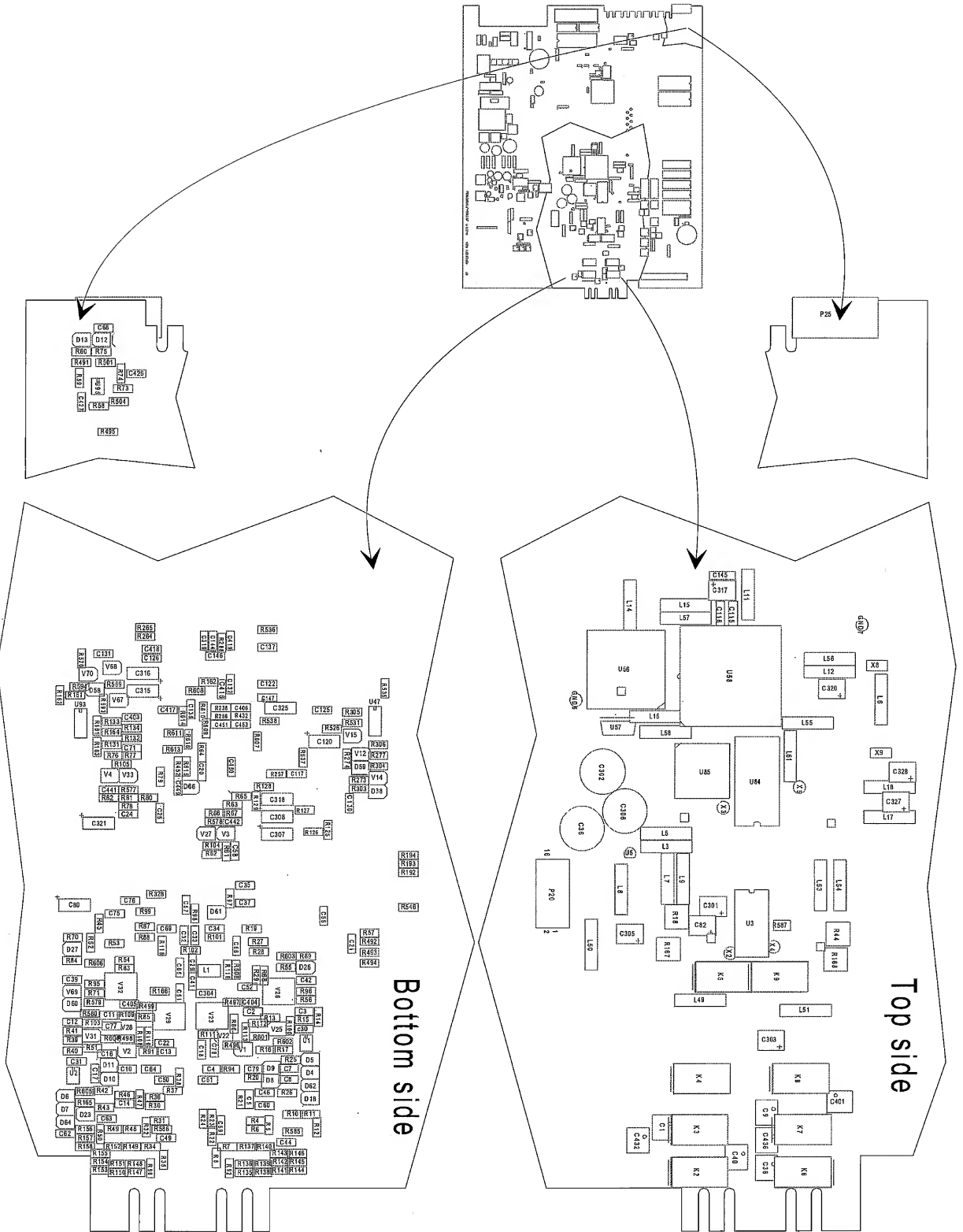
Component Numbers

| Letters | Components |
|---------|------------------------------|
| B | Crystals and crystal filters |
| C | Capacitors |
| D | Diodes |
| F | Fuses |
| G | Batteries |
| J | Jumpers and connectors |
| K | Relays |
| L | Coils |
| P | Connectors |
| R | Resistors |
| U | IC:s |
| V | Transistors |
| X | Test points |

The numbers are only sequential numbers.

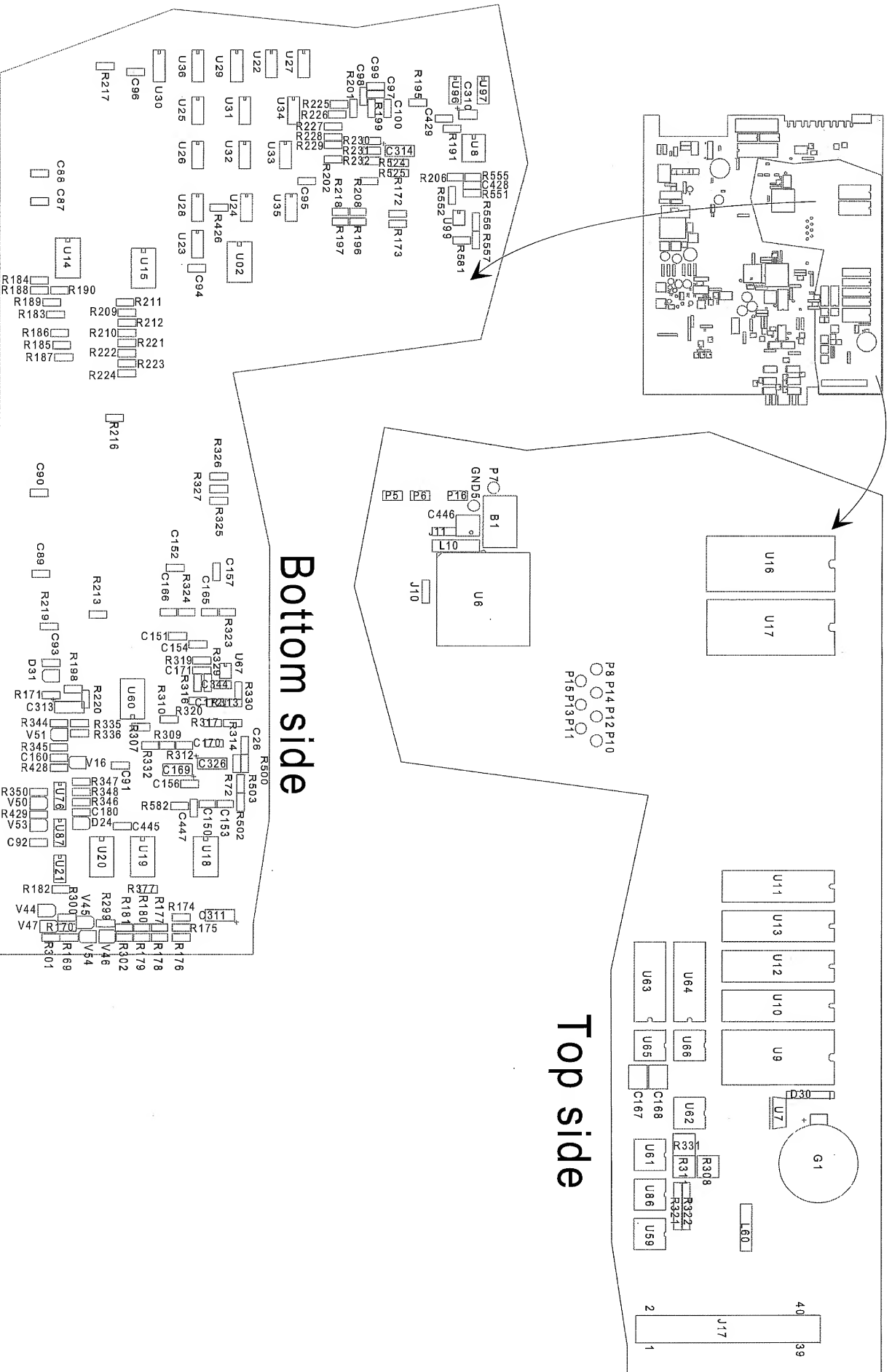
This page is intentionally left blank.

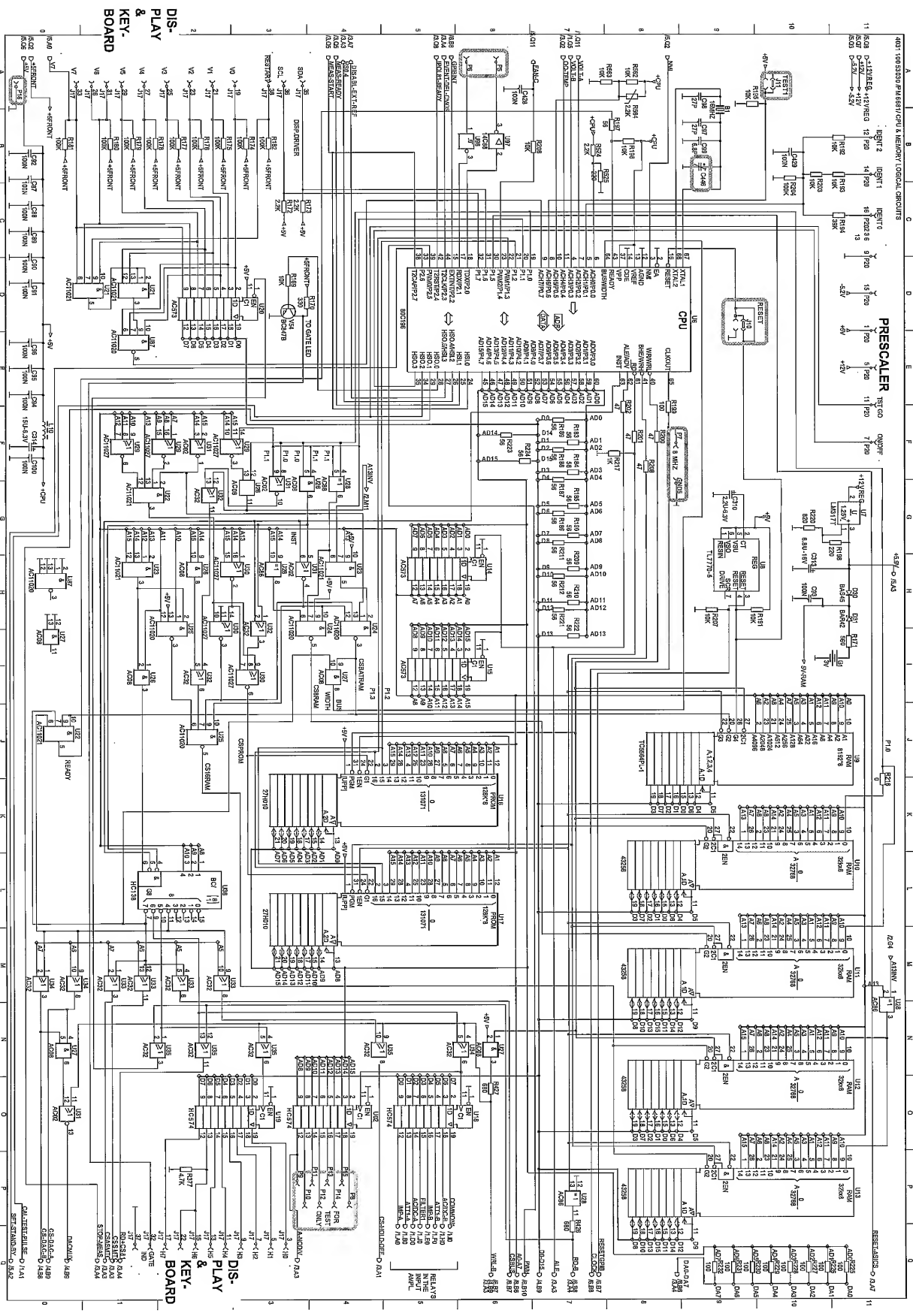
Basic board, Component layout



[illegible]

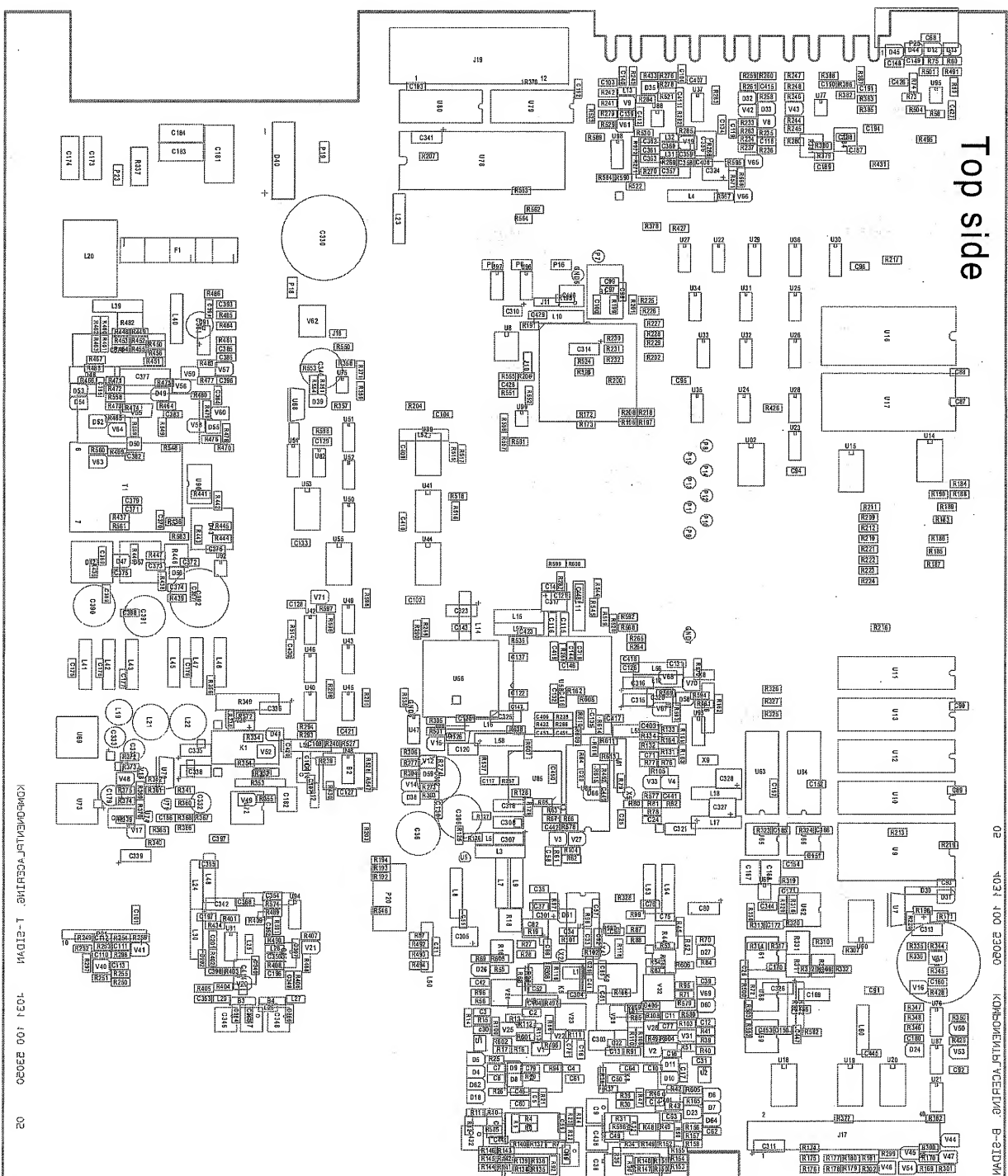
Basic board, Component layout

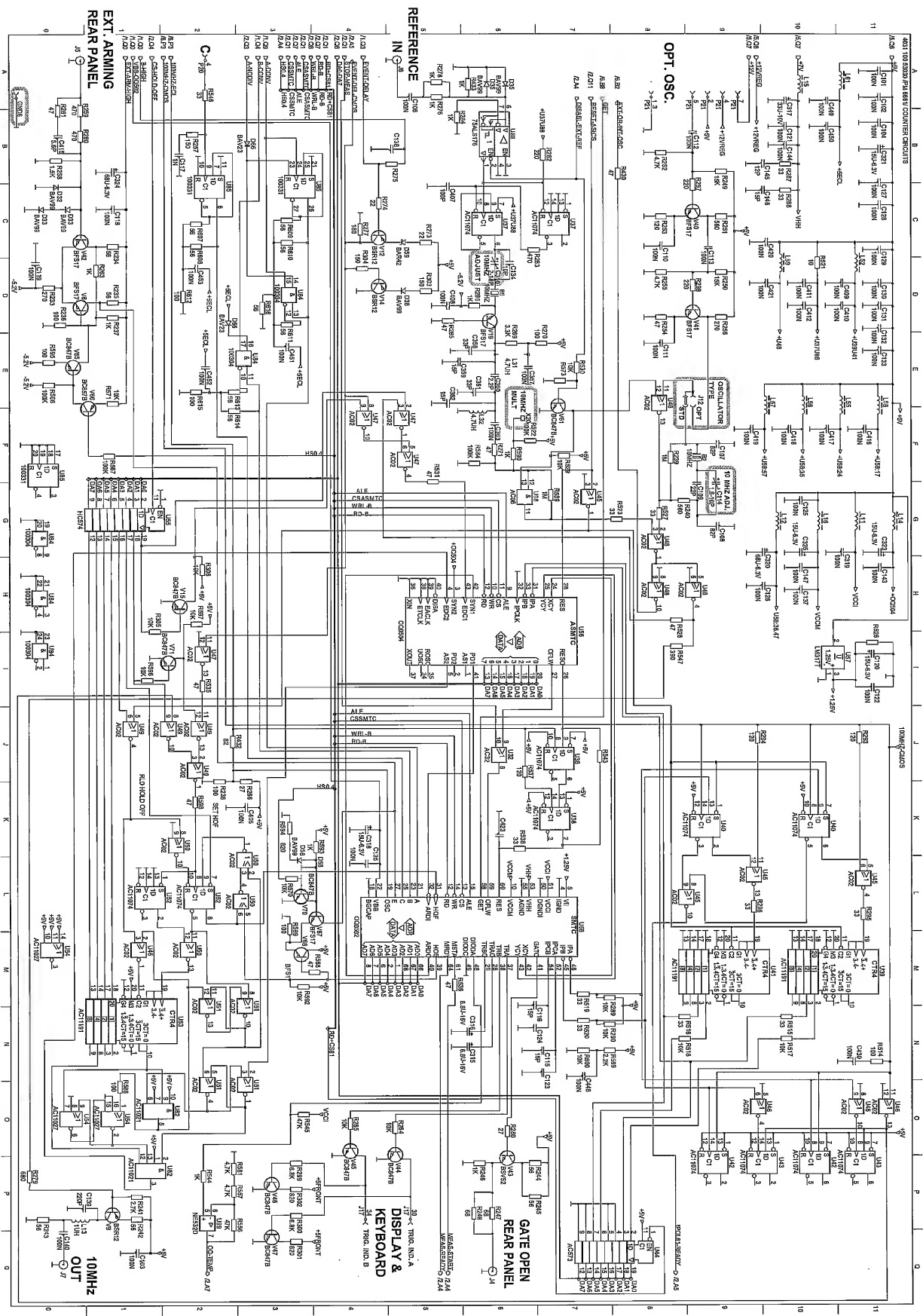




Top side

02 4034 100 23020 KOMBONIENL.BJ VCEBING B-SIDAM





4031 10053030.P/W/BBB/54/SC30A/2017/GER/LEN/EL/DAC



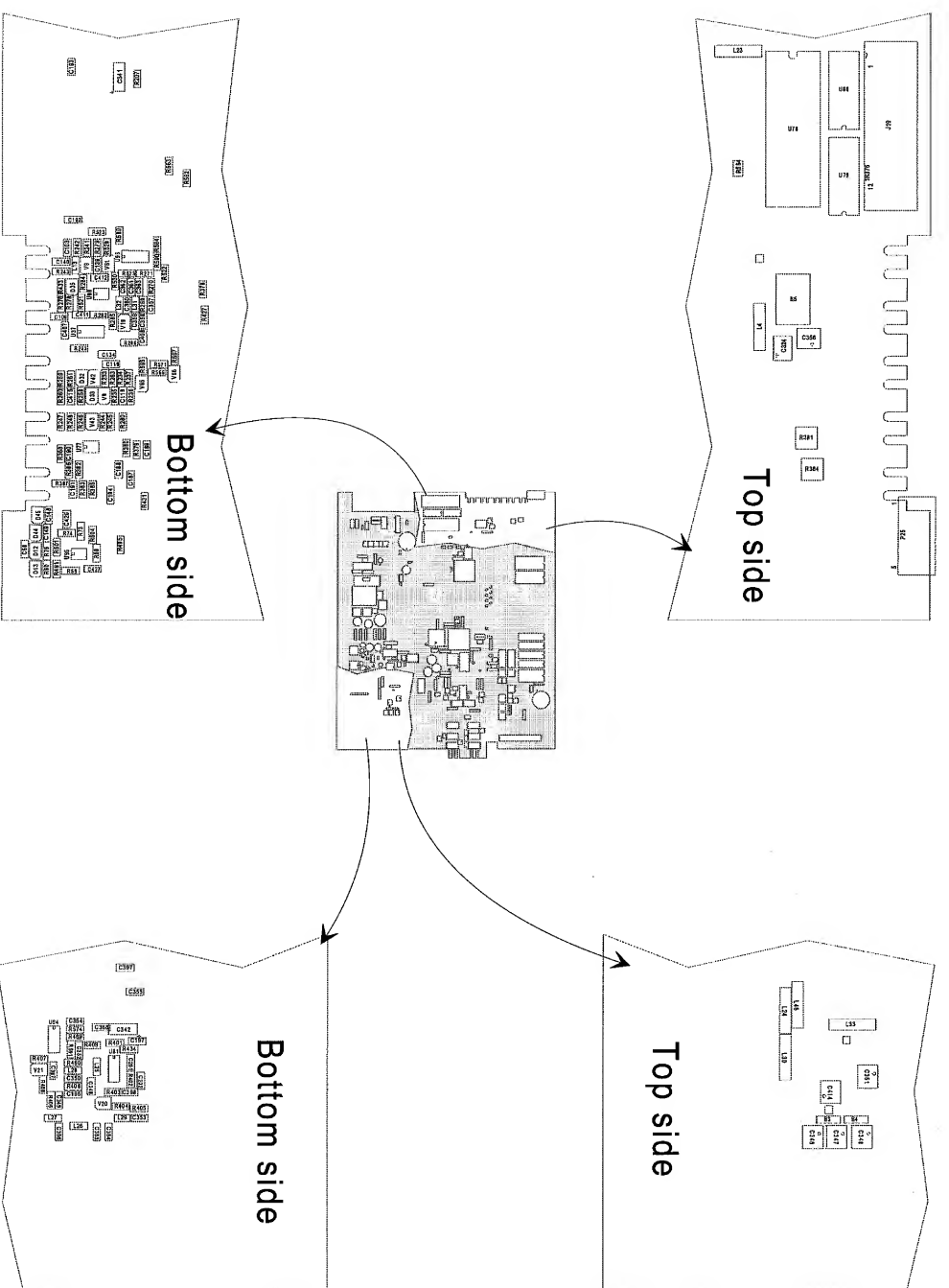
Top side

Bottom side

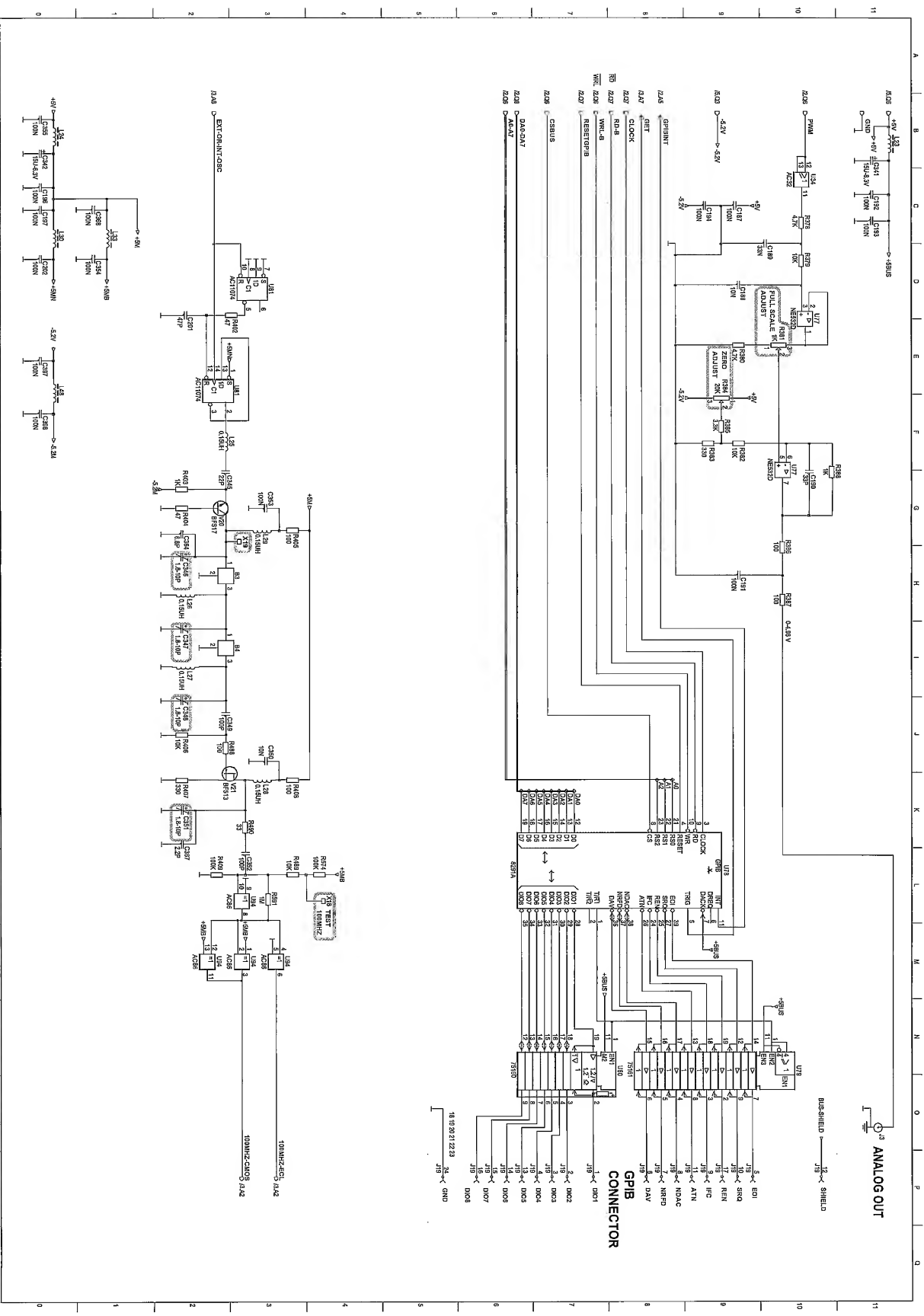
4031 100 53030 /PM 6681/ POWER SUPPLY CIRCUITS



Basic board, Component layout

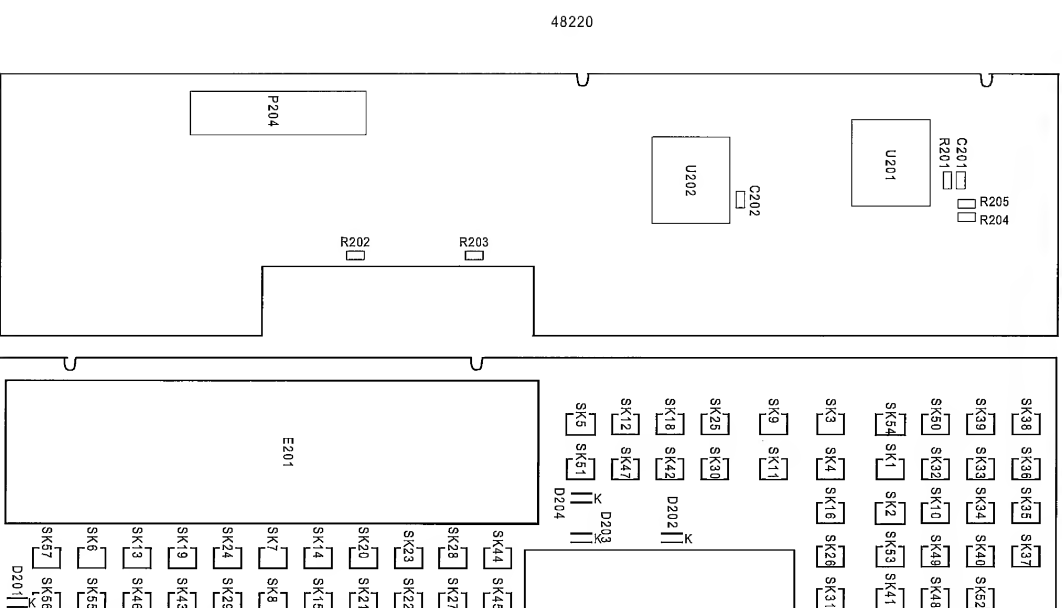


GPIB interface & Analog out, Unit 1 sheet 6(6)

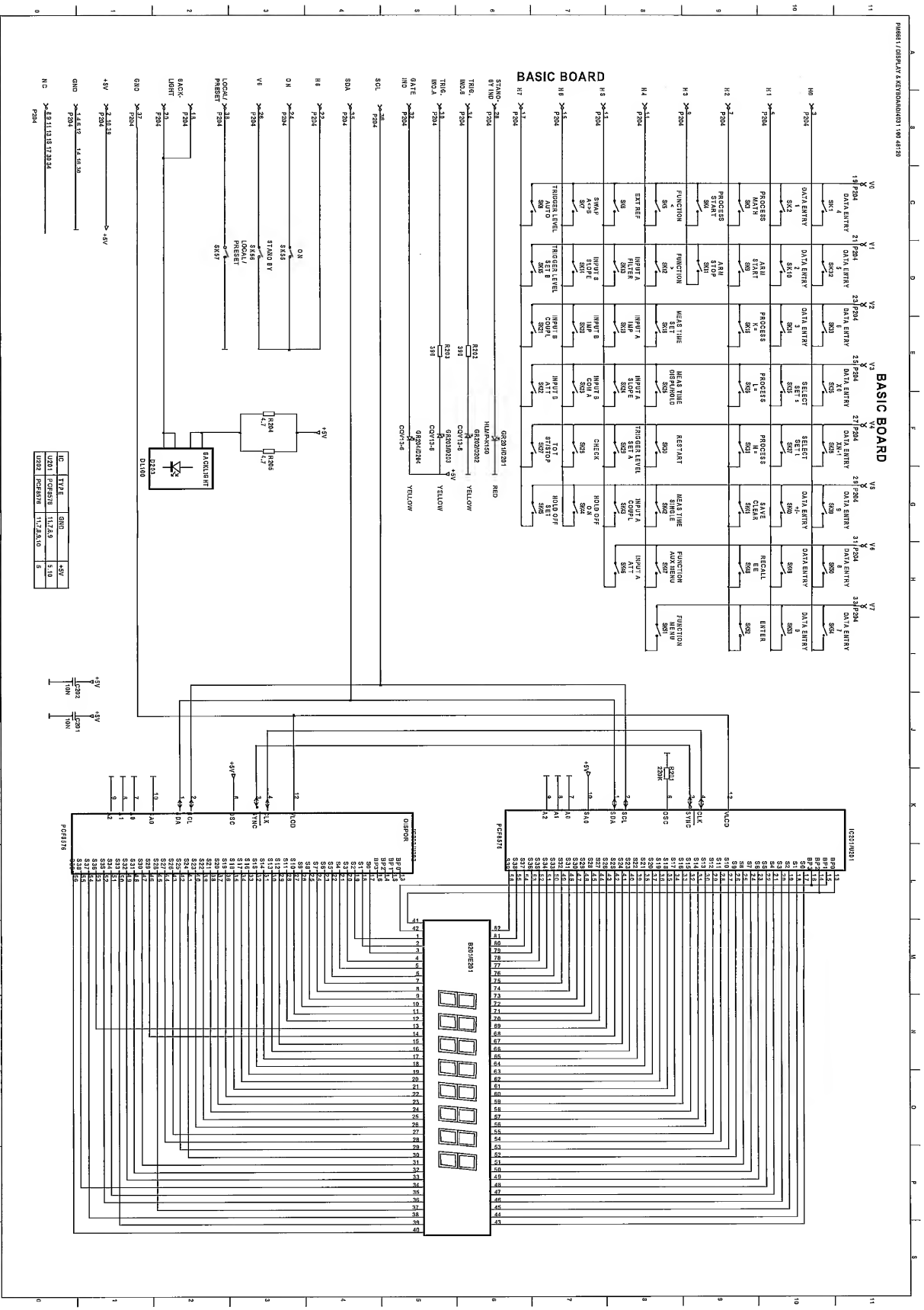


Display & Keyboard board, Component layout

| Display and keyboard board | | |
|----------------------------|---------|----------------------|
| IC | Type | GND +5 |
| U201 | PCF8576 | 7, 8, 9, 11 5, 10 |
| U202 | PCF8576 | 7, 8, 9, 10, 11 5 |

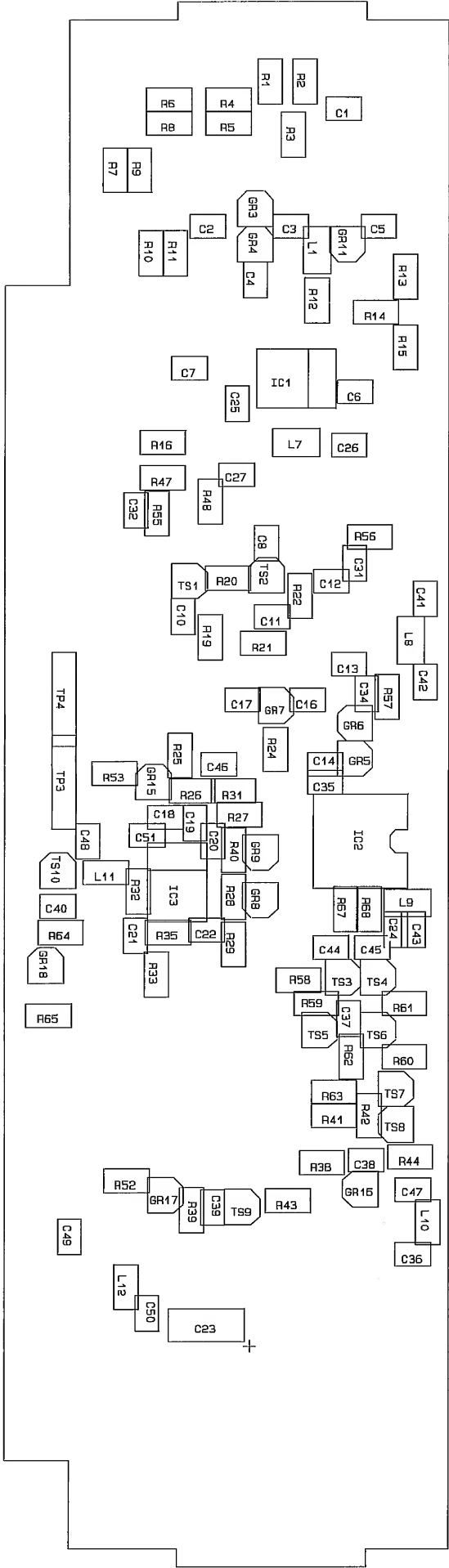


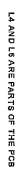
Display & Keyboard board, Unit 2



1.3 GHz HF-input, PM 9621, Component layout

| 1.3 GHz HF-input | | | |
|------------------|---------|------------|------|
| IC | Type | GND | +5 |
| IC1 | PC1652G | 2, 3, 4, 8 | 6, 7 |
| IC2 | U833BS | 4, 5 | 6 |
| IC3 | NE532D | 4, 8 | |





Chapter 9

Appendix

How to Replace Surface Mounted Devices

Most of the components in this instrument are mounted on the surface of the board instead of through holes in the board. These components are not hard to replace but they require another technique. If you do not have special SMD desoldering equipment, follow the instructions below:

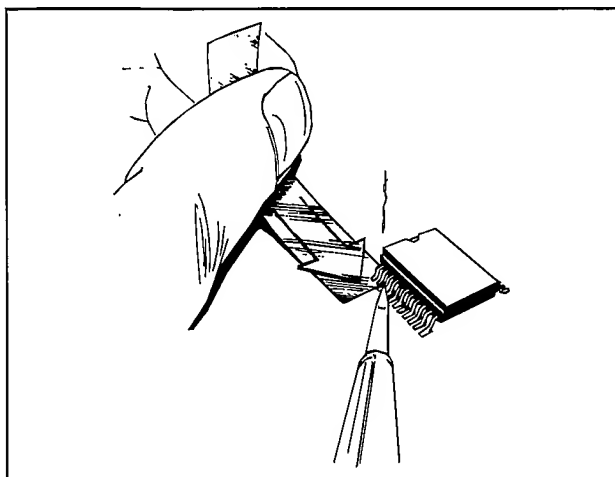


Figure 9-1 Heat the leads and push a thin aluminum sheet between the leads and the pca.

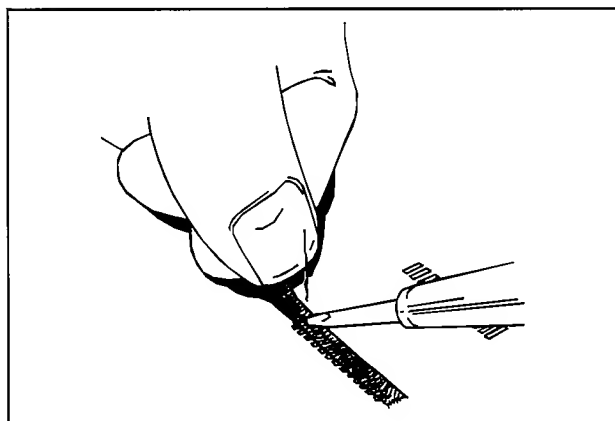


Figure 9-2 When removed, clean the pads with desoldering braid.

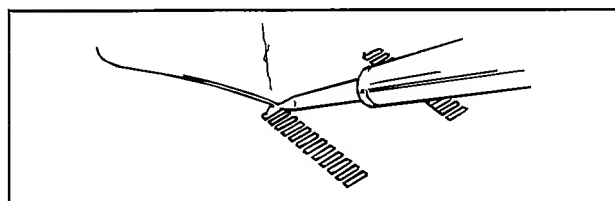


Figure 9-3 Place solder on the pad.

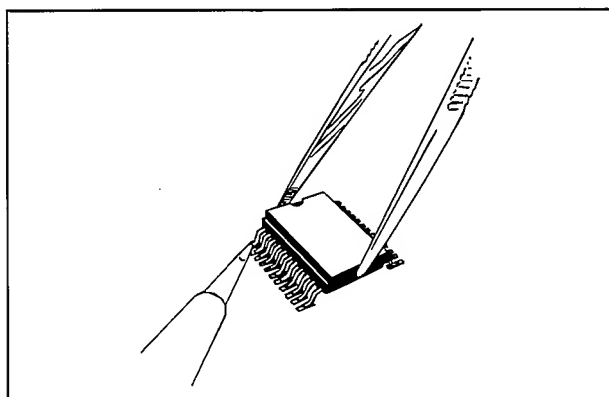


Figure 9-4 Attach the IC to the pad with solder.

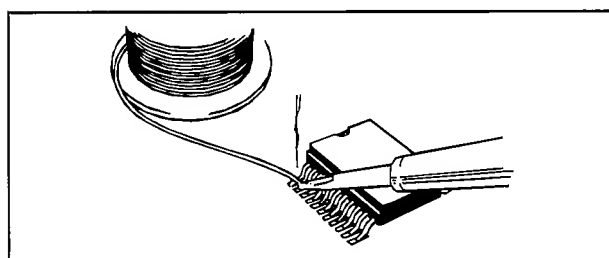


Figure 9-5 Solder all leads with plenty of solder, don't worry about short-circuits at this stage.

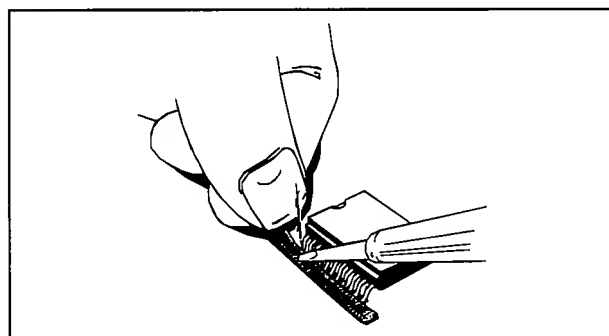


Figure 9-6 Remove excessive solder with desoldering braid..

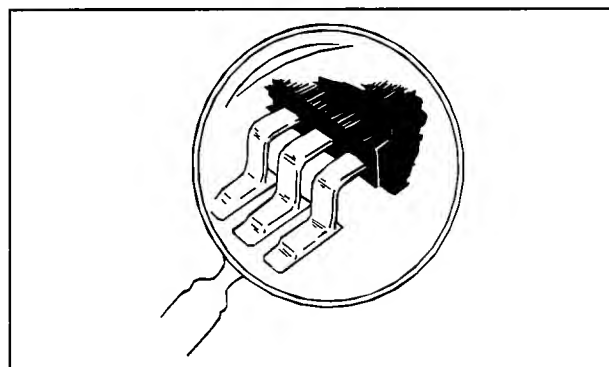


Figure 9-7 Use a strong magnifying glas to make sure there are no short/circuits or unsoldered leads.

Electrostatic discharge



Almost all modern components have extremely thin conductors and metal oxide layers. If these layers are exposed to electrostatic discharge they will break down or perhaps even worse, be damaged in a way that inevitably will cause a breakdown later on. The Electro-Static Discharge sensitivity of MOS and CMOS semiconductors have been known quite a while, but nowadays bipolar semiconductors and even precision resistors are ESD sensitive. Consider therefore all components, pc-boards and sub-assemblies as sensitive to electrostatic discharge. The text below explains how you can minimize the risk of damage or destroying these devices by being aware of the problems, and learning how to handle these components.

ESD sensitive options are packed in conductive containers marked with this symbol.

- *Never open the container unless you are at an ESD protected work station.*
- *Use a wrist strap grounded via a high resistance.*
- *Use a grounded work mat on your workbench.*
- *Never let your clothes come in contact with ESD sensitive equipment even when you are wearing a grounded wrist strap.*
- *Never touch the component leads.*
- *Never touch open connectors.*
- *Use ESD-safe packing materials.*
- *Use the packing material only once.*
- *Keep paper and nonconductive plastics etc. away from your workbench. These may block the discharge path to ground.*

Glossary

| | |
|-------------------------|---|
| A | |
| ASIC | Application Specific Integrated Circuit |
| C | |
| Calibration Adjustments | How to restore an instrument to perform in agreement with its specifications |
| CSA | Canadian Safety Association safety standard. |
| G | |
| GaAs | A technique to make very fast ICs using Gallium Arsenide substrat. |
| GPIB | General Purpose Instrumentation Bus used for inter-connecting several measuring instruments to a common controller. |
| I | |
| I ² C-bus | An internal address- and data bus for communication between microcontroller, measuring logic, and options. |
| IEC 1010-1 | International Electrical Commission safety standard. |
| L | |
| LSI | Large Scale Intergrated circuit |
| O | |
| OCXO | Oven Controlled X-tal Oscillator |
| P | |
| PCA | Printed Circuit Assembly |
| Performance Check | A procedure to check that the instrument is functionally operational and performs to its specification. Must not require opening of cabinet. If the instrument passes the check it is considered as calibrated. |
| PWM | Pulse Width Modulated |
| U | |
| UCXO | Un-Compensated X-tal Oscillator (standard) |

Unit 1

The main printed-circuit board (Unit 1) has recently been redesigned due to obsolescence of a number of integrated circuits. Designations found in circuit descriptions, schematic diagrams and parts lists in the first eight chapters refer to the original design. The functional descriptions are correct on the whole, if you make a few substitutions. A new set of schematic diagrams and a new replacement parts list are included in this chapter.

- Instruments having serial numbers >784919 belong to the new generation.
- The model PM6681R/676/AF has only been produced with the new Unit 1 board, so the serial number is irrelevant in this case.

Replacement Parts

| Pos | Description | Part Number ☆ | Pos | Description | Part Number ☆ |
|------|---------------------------------------|------------------|------|---------------------------------------|------------------|
| 1 | CIRCUIT DIAGRAM PM6681 BAS81 | 4031 100 53030 | C114 | CAPACITOR 10.0pF 1.8-10PF 300V | 5322 125 50049 S |
| 2 | PC-BOARD PM6681:1 BAS81 | 4031 100 53050 | C115 | CAPACITOR 15.0pF 2% 100V NP0 2M | 4822 122 31823 S |
| 8 | NUT M6M 03 ST FZB | 4822 505 10758 P | C116 | CAPACITOR 15.0pF 2% 100V NP0 2M | 4822 122 31823 S |
| 9 | SCREW MRT 3X10 ST FZB TX | 5322 502 21644 P | C117 | CAPACITOR 1nF 5% 63V NP0 1206 | 4822 122 31746 S |
| 11 | LOCK WASHER AZ3.2 ST FZ DIN6798A | 4822 530 80082 P | C118 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| 12 | SPRING WASHER KBA 3.2 ST FZ DIN137 | 4822 530 80173 P | C119 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| 13 | WASHER BRB 3.2x8x1 ST FZ | 4031 105 00120 | C12 | CAPACITOR 1nF 5% 63V NP0 1206 | 4822 122 31746 S |
| 15 | LABEL STATUS 25.4X12.7 POLYIMIDE | 5322 454 13144 P | C120 | CAPACITOR 15 µF 20% 6.3V 6.0X3.2 MOLD | 5322 124 11418 S |
| 28 | TAPE-DOUBLE COATED 6.4mm 4032 | 1222 100 20001 | C121 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| 39 | SHIELD PM6681 | 5322 459 11185 P | C122 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| 40 | SHIELD COVER PM6681 | 5322 447 92204 P | C125 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| 54 | SCREW MRT 3X06 ST FZB TX | 4822 502 11658 P | C126 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| 61 | CONNECTOR-COAX BNC | 5322 267 10004 S | C127 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| 64 | SOLDERING LUG 10.0X15/21 CU SN | 4031 100 58390 | C128 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| 66 | TOROID CORE 30nH RCC9/6/3 4C65 VIOLET | 5322 526 10545 P | C129 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| 70 | BNC HOLDER PM6680,81,85 | 4031 100 48830 | C13 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| 102 | WASHER 9.5X13X2.3 PM6680,81,85 | 4822 532 10222 P | C130 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| 205 | CABLE WZT2801 Green | 731 159 00002 | C131 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| 206 | CABLE WZT 2801 Grey | 731 159 00003 | C132 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| 207 | STRAP SST-1M NATURELL L=102mm b=2.4 | 2422 015 05037 | C133 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| 208 | FXF TUBE 3B 4.3x2 L=7.2 | 4822 526 10097 S | C134 | CAPACITOR 10pF 5% 63V NP0 1206 | 4822 122 31971 S |
| B1 | CRYSTAL 16MHz PM5781 HC-49/U | 5322 242 73307 S | C135 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| B2 | CRYSTAL 10MHz HC-49U/13 | 5322 242 82118 R | C136 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| B3 | CRYSTALFILTER 100MHz MF UB | 5322 242 81692 S | C137 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| B4 | CRYSTALFILTER 100MHz MF UB | 5322 242 81692 S | C138 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| B5 | CRYSTAL 10MHz HC-49U | 5322 242 81694 R | C139 | CAPACITOR 220pF 5% 63V NP0 1206 | 4822 122 31965 S |
| C1 | CAPACITOR 2.00pF 0.5-2pF 300V | 5322 124 80335 S | C14 | CAPACITOR 22nF 10% 200V X7R 1206 | 5322 126 14081 R |
| C10 | CAPACITOR 1nF 5% 63V NP0 1206 | 4822 122 31746 S | C140 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| C100 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S | C143 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| C101 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S | C144 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| C102 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S | C145 | CAPACITOR 12.0pF 2% 100V NP0 2M | 4822 122 31056 S |
| C103 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S | C146 | CAPACITOR 15pF 5% 63V NP0 1206 | 4822 122 32504 S |
| C104 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S | C147 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| C106 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S | C148 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| C107 | CAPACITOR 82pF 5% 63V NP0 1206 | 4822 122 31839 S | C149 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| C108 | CAPACITOR 82pF 5% 63V NP0 1206 | 4822 122 31839 S | C150 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| C109 | CAPACITOR 22pF 5% 63V NP0 1206 | 4822 122 32482 S | C151 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| C11 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S | C152 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| C110 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S | C153 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| C111 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S | C154 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| C112 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S | C156 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| C113 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S | C157 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |

| Pos | Description | Part Number ☆ |
|------|---|----------------|
| C16 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C160 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C165 | CAPACITOR 33pF 5% 63V NP0 1206 | 4822 126 10324 |
| C166 | CAPACITOR 33pF 5% 63V NP0 1206 | 4822 126 10324 |
| C167 | CAPACITOR 1uF 10% 50V MMKO-5 PETP | 5322 121 42515 |
| C168 | CAPACITOR 1uF 10% 50V MMKO-5 PETP | 5322 121 42515 |
| C169 | CAPACITOR 15 uF 20% 6.3V 6.0X3.2 MOLD | 5322 124 11418 |
| C17 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C170 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C171 | CAPACITOR 33pF 5% 63V NP0 1206 | 4822 126 10324 |
| C172 | CAPACITOR 33pF 5% 63V NP0 1206 | 4822 126 10324 |
| C173 | CAPACITOR 2.20nF PME289MA4220MR04 | 5322 121 43756 |
| C174 | CAPACITOR 2.20nF PME289MA4220MR04 | 5322 121 43756 |
| C175 | RESISTOR 0 ohm BYGLING RC-01 1206 | 4822 051 10008 |
| C176 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C177 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C178 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C179 | CAPACITOR 100uF 20% 35V 2M 8.2x11 | 5322 124 40852 |
| C18 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C180 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C181 | CAPACITOR 100nF 10% 250V | 2222 336 20104 |
| C182 | CAPACITOR 1uF 10% 50V MMKO-5 PETP | 5322 121 42515 |
| C183 | CAPACITOR 2.20nF PME289MA4220MR04 | 5322 121 43756 |
| C184 | CAPACITOR 2.20nF PME289MA4220MR04 | 5322 121 43756 |
| C186 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C187 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C188 | CAPACITOR 10.0nF 10% 63V X7R 1206 | 4822 122 32442 |
| C189 | CAPACITOR 33.0nF 10% 50V X7R 1206 | 4822 122 31981 |
| C190 | CAPACITOR 33pF 5% 63V NP0 1206 | 4822 126 10324 |
| C191 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C192 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C193 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C194 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C196 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C197 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C2 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C20 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C201 | CAPACITOR 47pF 5% 63V NP0 1206 | 4822 122 31772 |
| C202 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C21 | CAPACITOR 1nF 5% 63V NP0 1206 | 4822 122 31746 |
| C22 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C24 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C25 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C26 | CAPACITOR 1nF 5% 63V NP0 1206 | 4822 122 31746 |
| C29 | CAPACITOR 10.0nF 10% 63V X7R 1206 | 4822 122 32442 |
| C3 | CAPACITOR 1nF 5% 63V NP0 1206 | 4822 122 31746 |
| C30 | CAPACITOR 10.0nF 10% 63V X7R 1206 | 4822 122 32442 |
| C302 | CAPACITOR 2200uF 20% 16V RAD 2M 12.5X25 | 4822 124 40723 |
| C303 | CAPACITOR 68uF 20% 6.3V SOLID AL | 5322 124 10455 |
| C304 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C305 | CAPACITOR 68uF 20% 6.3V SOLID AL | 5322 124 10455 |
| C306 | CAPACITOR 2200uF 20% 16V RAD 2M 12.5X25 | 4822 124 40723 |
| C307 | CAPACITOR 15 uF 20% 6.3V 6.0X3.2 MOLD | 5322 124 11418 |
| C308 | CAPACITOR 15 uF 20% 6.3V 6.0X3.2 MOLD | 5322 124 11418 |
| C31 | CAPACITOR 10.0nF 10% 63V X7R 1206 | 4822 122 32442 |
| C310 | CAPACITOR 2.20 uF 20% 6.3V 3.2X1.6 MOLD | 5322 124 10685 |
| C311 | CAPACITOR 15 uF 20% 6.3V 6.0X3.2 MOLD | 5322 124 11418 |
| C313 | CAPACITOR 6.80 uF 20% 16V 6.0X3.2 MOLD | 5322 124 10687 |
| C314 | CAPACITOR 15 uF 20% 6.3V 6.0X3.2 MOLD | 5322 124 11418 |
| C315 | CAPACITOR 6.80 uF 20% 16V 6.0X3.2 MOLD | 5322 124 10687 |
| C316 | CAPACITOR 6.80 uF 20% 16V 6.0X3.2 MOLD | 5322 124 10687 |
| C317 | CAPACITOR 33uF 20% 10V SOLID AL | 5322 124 11084 |
| C318 | CAPACITOR 15 uF 20% 6.3V 6.0X3.2 MOLD | 5322 124 11418 |
| C319 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C32 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C320 | CAPACITOR 68uF 20% 6.3V SOLID AL | 5322 124 10455 |
| C321 | CAPACITOR 15 uF 20% 6.3V 6.0X3.2 MOLD | 5322 124 11418 |
| C323 | CAPACITOR 15 uF 20% 6.3V 6.0X3.2 MOLD | 5322 124 11418 |
| C324 | CAPACITOR 68uF 20% 6.3V SOLID AL | 5322 124 10455 |
| C325 | CAPACITOR 15 uF 20% 6.3V 6.0X3.2 MOLD | 5322 124 11418 |
| C326 | CAPACITOR 15 uF 20% 6.3V 6.0X3.2 MOLD | 5322 124 11418 |
| C327 | CAPACITOR 68uF 20% 6.3V SOLID AL | 5322 124 10455 |
| C328 | CAPACITOR 68uF 20% 6.3V SOLID AL | 5322 124 10455 |
| C329 | CAPACITOR 68uF 20% 6.3V SOLID AL | 5322 124 10455 |
| C33 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C330 | CAPACITOR 270uF 20% SMG 400V 25X45 | 5322 124 80334 |
| C331 | CAPACITOR 100uF 20% 35V 2M 8.2x11 | 5322 124 40852 |
| C332 | CAPACITOR 100uF 20% 35V 2M 8.2x11 | 5322 124 40852 |
| C333 | CAPACITOR 100uF 20% 35V 2M 8.2x11 | 5322 124 40852 |
| C334 | CAPACITOR 68uF 20% 6.3V SOLID AL | 5322 124 10455 |
| C335 | CAPACITOR 6.80 uF 20% 16V 6.0X3.2 MOLD | 5322 124 10687 |
| C336 | CAPACITOR 15 uF 20% 6.3V 6.0X3.2 MOLD | 5322 124 11418 |
| C338 | CAPACITOR 6.80 uF 20% 16V 6.0X3.2 MOLD | 5322 124 10687 |
| C339 | CAPACITOR 6.80 uF 20% 16V 6.0X3.2 MOLD | 5322 124 10687 |
| C34 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C340 | CAPACITOR 470uF 20% 35V 2M 12.5x20 | 5322 126 13131 |
| C341 | CAPACITOR 15 uF 20% 6.3V 6.0X3.2 MOLD | 5322 124 11418 |
| C342 | CAPACITOR 15 uF 20% 6.3V 6.0X3.2 MOLD | 5322 124 11418 |
| C344 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C345 | CAPACITOR 22pF 5% 63V NP0 1206 | 4822 122 32482 |
| C346 | CAPACITOR 3.5pF 1.2-3.5pF 300V 2M 6x8x9 | 2222 809 05215 |
| C347 | CAPACITOR 10.0pF 1.8-10pF 300V | 5322 125 50049 |
| C348 | CAPACITOR 3.5pF 1.2-3.5pF 300V 2M 6x8x9 | 2222 809 05215 |
| C35 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C350 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C351 | CAPACITOR 10.0pF 1.8-10pF 300V | 5322 125 50049 |
| C352 | CAPACITOR 100pF 5% 50V NP0 0805 | 2222 861 15101 |
| B | | |
| C353 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C354 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C355 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |
| C356 | CAPACITOR 18.0pF 2.0-18pF 300V | 2222 809 05217 |
| C357 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 |

| Pos | Description | Part Number | ☆ |
|------|--|----------------|----|
| C358 | CAPACITOR 33pF 5% 63V NP0 1206 | 4822 126 10324 | SS |
| C359 | CAPACITOR 15pF 5% 63V NP0 1206 | 4822 122 32504 | SS |
| C36 | CAPACITOR 2200uF 20% 16V RAD 2M 12.5X25 | 4822 124 40723 | SS |
| C360 | CAPACITOR 2.2pF ±0.25pF 63V NP0 1206 | 4822 863 15228 | SS |
| C361 | CAPACITOR 33pF 5% 63V NP0 1206 | 4822 126 10324 | SS |
| C362 | CAPACITOR 15pF 5% 63V NP0 1206 | 4822 122 32504 | SS |
| C363 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C364 | CAPACITOR 8.2pF ±0.25pF 50V N750 1206SMD | 2020 552 95905 | SS |
| C365 | CAPACITOR 8.2pF ±0.25pF 50V N750 1206SMD | 2020 552 95905 | SS |
| C366 | CAPACITOR 5.6pF ±0.25pF 50V N750 1206SMD | 2020 552 95871 | SS |
| C367 | CAPACITOR 8.2pF ±0.25pF 50V N750 1206SMD | 2020 552 95905 | SS |
| C368 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C369 | CAPACITOR 1nF 5% 63V NP0 1206 | 4822 122 31746 | SS |
| C37 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C370 | CAPACITOR 1nF 5% 63V NP0 1206 | 4822 122 31746 | SS |
| C371 | CAPACITOR 220pF 5% 63V NP0 1206 | 4822 122 31965 | SS |
| C372 | CAPACITOR 33.0nF 10% 50V X7R 1206 | 4822 122 31981 | SS |
| C373 | CAPACITOR 33.0nF 10% 50V X7R 1206 | 4822 122 31981 | SS |
| C374 | CAPACITOR 33.0nF 10% 50V X7R 1206 | 4822 122 31981 | SS |
| C375 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C376 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C377 | CAPACITOR 47nF 10% 250V POLYCARB | 4822 121 41676 | SS |
| C378 | CAPACITOR 330nF 20% 250V | 2222 336 20334 | SS |
| C379 | CAPACITOR 220pF 5% 63V NP0 1206 | 4822 122 31965 | SS |
| C38 | CAPACITOR 18.0pF 2.0-18pF 300V | 2222 809 05217 | SS |
| C381 | CAPACITOR 100uF 20% 35V 2M 8.2x11 | 5322 124 40852 | SS |
| C382 | CAPACITOR 220pF 5% 63V NP0 1206 | 4822 122 31965 | SS |
| C383 | CAPACITOR 100pF 5% 63V NP0 1206 | 4822 122 31765 | SS |
| C384 | CAPACITOR 22pF 5% 63V NP0 1206 | 4822 122 32482 | SS |
| C385 | CAPACITOR 4.70nF 10% 63V X7R 1206 | 4822 122 31784 | SS |
| C386 | CAPACITOR 4.70nF 10% 63V X7R 1206 | 4822 122 31784 | SS |
| C387 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C388 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C389 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C39 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C390 | CAPACITOR 470uF 20% 35V 2M 12.5x20 | 5322 126 13131 | SS |
| C391 | CAPACITOR 470uF 20% 35V 2M 12.5x20 | 5322 126 13131 | SS |
| C392 | CAPACITOR 10000uF 20% 6.3V 3M 18x35 | 5322 124 80821 | SS |
| C393 | CAPACITOR 1nF 5% 63V NP0 1206 | 4822 122 31746 | SS |
| C394 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C395 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C396 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C397 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C398 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C4 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C40 | CAPACITOR 18.0pF 2.0-18pF 300V | 2222 809 05217 | SS |
| C403 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C404 | CAPACITOR 12pF 5% 63V NP0 1206 | 4822 122 32139 | SS |
| C405 | CAPACITOR 12pF 5% 63V NP0 1206 | 4822 122 32139 | SS |
| C406 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C407 | CAPACITOR 100pF 5% 63V NP0 1206 | 4822 122 31765 | SS |
| C408 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C409 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C41 | CAPACITOR 10.0nF 10% 63V X7R 1206 | 4822 122 32442 | SS |
| C410 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C411 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C412 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C415 | CAPACITOR 5.6pF ±0.5pF 63V NP0 1206 | 4822 122 32506 | SS |
| C416 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C417 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C418 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C419 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C42 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C420 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C421 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C426 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C427 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C428 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C429 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C430 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C432 | CAPACITOR 18.0pF 2.0-18pF 300V | 2222 809 05217 | SS |
| C436 | CAPACITOR 18.0pF 2.0-18pF 300V | 2222 809 05217 | SS |
| C44 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C441 | CAPACITOR 12pF 5% 63V NP0 1206 | 4822 122 32139 | SS |
| C442 | CAPACITOR 12pF 5% 63V NP0 1206 | 4822 122 32139 | SS |
| C445 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C447 | CAPACITOR 33pF 5% 63V NP0 1206 | 4822 126 10324 | SS |
| C448 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C449 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C450 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C451 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C452 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C453 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C454 | CAPACITOR 1nF 5% 63V NP0 1206 | 4822 122 31746 | SS |
| C455 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C456 | CAPACITOR 68uF 20% 6.3V SOLID AL | 5322 124 10455 | SS |
| C457 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C46 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C49 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C5 | CAPACITOR 22nF 10% 200V X7R 1206 | 5322 126 14081 | SS |
| C50 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C51 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C52 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C55 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C57 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C58 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C59 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C60 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C61 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C62 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C63 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C64 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C65 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |
| C66 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 | SS |

| Pos | Description | Part Number ☆ |
|-----|---|------------------|
| C68 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| C69 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| C7 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| C71 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| C75 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| C76 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| C77 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| C78 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| C79 | CAPACITOR 1nF 5% 63V NP0 1206 | 4822 122 31746 S |
| C8 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| C80 | CAPACITOR 15 µF 20% 6.3V 6.0X3.2 MOLD | 5322 124 11418 S |
| C82 | CAPACITOR 68µF 20% 6.3V SOLID AL | 5322 124 10455 S |
| C87 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| C88 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| C89 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| C9 | CAPACITOR 2.00pF 0.5-2pF 300V | 5322 124 80335 S |
| C90 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| C91 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| C92 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| C93 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| C94 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| C95 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| C96 | CAPACITOR 100nF 10% 63V X7R 1206 | 4822 122 33496 S |
| C97 | CAPACITOR 18pF 5% 63V NP0 1206 | 2222 863 15189 S |
| C98 | CAPACITOR 47pF 5% 63V NP0 1206 | 4822 122 31772 S |
| C99 | CAPACITOR 18pF 5% 63V NP0 1206 | 2222 863 15189 S |
| D10 | DIODE 0.10A BAT18 35V 1PF SOT23 | 5322 130 32076 S |
| D11 | DIODE 0.10A BAT18 35V 1PF SOT23 | 5322 130 32076 S |
| D12 | DIODE 0.10A BAV99 SOT23 | 5322 130 34337 S |
| D13 | DIODE 0.10A BAV99 SOT23 | 5322 130 34337 S |
| D18 | DIODE 0.10A BAV99 SOT23 | 5322 130 34337 S |
| D23 | DIODE 0.10A BAV99 SOT23 | 5322 130 34337 S |
| D24 | DIODE 0.10A BAR42 30V SOT23 | 5322 130 83586 S |
| D26 | DIODE 0.10A BAV99 SOT23 | 5322 130 34337 S |
| D27 | DIODE 0.10A BAV99 SOT23 | 5322 130 34337 S |
| D30 | DIODE 0.15A BAS45 DO-35 | 5322 130 32256 S |
| D31 | DIODE 0.10A BAR42 30V SOT23 | 5322 130 83586 S |
| D32 | DIODE 0.10A BAV99 SOT23 | 5322 130 34337 S |
| D33 | DIODE 0.10A BAV99 SOT23 | 5322 130 34337 S |
| D35 | DIODE 0.10A BAV99 SOT23 | 5322 130 34337 S |
| D38 | DIODE 0.10A BAV99 SOT23 | 5322 130 34337 S |
| D4 | DIODE 0.10A BAV99 SOT23 | 5322 130 34337 S |
| D40 | BRIDGE RECTIF 4A KBU4K 800V | 4822 130 80497 S |
| D41 | DIODE 0.25A BAW56 70V SOT23 | 5322 130 30691 S |
| D42 | DIODE 7A BYW29/200 TO-220AC | 5322 130 32328 S |
| D43 | DIODE 7.5A MBR760 60V TO220 | 5322 130 83602 S |
| D43 | HEAT SINK 16øK/W LÖDBAR TO217 | 5322 255 41313 S |
| D44 | DIODE 0.10A BAV99 SOT23 | 5322 130 34337 S |
| D45 | DIODE 0.10A BAV99 SOT23 | 5322 130 34337 S |
| D47 | DIODE 0.35 W BZX84-C8V2 SOT23 | 5322 130 80255 S |
| D48 | DIODE BYV26E DOP57 | 4822 130 60815 S |
| D49 | DIODE 0.35 W BZX84-C18 SOT23 | 5322 130 80212 S |
| D5 | DIODE 0.10A BAV99 SOT23 | 5322 130 34337 S |
| D50 | DIODE 0.2A BAV23 200V SOT143 | 5322 130 33764 S |
| D52 | DIODE 0.35 W BZX84-C18 SOT23 | 5322 130 80212 S |
| D53 | DIODE 0.35 W BZX84-C18 SOT23 | 5322 130 80212 S |
| D54 | DIODE 0.35 W BZX84-C8V2 SOT23 | 5322 130 80255 S |
| D55 | DIODE 0.2A BAV23 200V SOT143 | 5322 130 33764 S |
| D56 | DIODE 0.2A BAV23 200V SOT143 | 5322 130 33764 S |
| D57 | DIODE 7A BYW29/200 TO-220AC | 5322 130 32328 S |
| D57 | HEAT SINK 16øK/W LÖDBAR TO218 | 5322 255 41313 S |
| D58 | DIODE 0.10A BAV99 SOT23 | 5322 130 34337 S |
| D59 | DIODE 0.10A BAR42 30V SOT23 | 5322 130 83586 S |
| D6 | DIODE 0.10A BAV99 SOT23 | 5322 130 34337 S |
| D60 | DIODE 0.35W BZX84-B5V6 2% SOT23 | 4822 130 33004 S |
| D61 | DIODE 0.10A BAV99 SOT23 | 5322 130 34337 S |
| D62 | DIODE 0.10A BAV99 SOT23 | 5322 130 34337 S |
| D64 | DIODE 0.10A BAV99 SOT23 | 5322 130 34337 S |
| D66 | DIODE 0.2A BAV23 200V SOT143 | 5322 130 33764 S |
| D7 | DIODE 0.10A BAV99 SOT23 | 5322 130 34337 S |
| D8 | DIODE 0.10A BAT18 35V 1PF SOT23 | 5322 130 32076 S |
| D9 | DIODE 0.10A BAT18 35V 1PF SOT23 | 5322 130 32076 S |
| F1 | FUSE HOLDER 011 656 5X20mm | 4822 256 30139 S |
| G1 | BATTERY HOLDER 20mm BH800 KNAPPCELL | 5322 256 60311 S |
| GND | CONNECTOR 3 POL F095 SINGLE ROW | 5322 290 60445 S |
| 5 | GND | |
| 6 | GND | |
| 6 | CONNECTOR 3 POL F095 SINGLE ROW | 5322 290 60445 S |
| 7 | GND | |
| J12 | CONNECTOR 2POL F095 JUMPER GREY | 5322 263 50101 S |
| J12 | CONNECTOR 3 POL F095 SINGLE ROW | 5322 290 60445 S |
| J15 | CONNECTOR 2POL F095 JUMPER GREY | 5322 263 50101 S |
| J15 | CONNECTOR 3 POL F095 SINGLE ROW | 5322 290 60445 S |
| J17 | CABLE ASSY PM6681 | 5322 321 62336 S |
| J18 | CONNECTOR 2 POL F095 SINGLE ROW | 5322 265 44074 S |
| J19 | CONNECTOR 24 POL 57LE-20240-77OOD35G | 5322 267 60148 S |
| J22 | CONNECTOR 2 POL F095 SINGLE ROW | 5322 265 44074 S |
| J23 | CONNECTOR 2 POL F095 SINGLE ROW | 5322 265 44074 S |
| K1 | RELAY 2p vx V23042-A1003-B101 (alt.A2303) | 5322 280 60557 S |
| K2 | RELAY TQ2-5 SV/1A 2pol vx 14X9X5m | 5322 280 20514 S |
| K3 | RELAY TQ2-5 SV/1A 2pol vx 14X9X5m | 5322 280 20514 S |
| K4 | RELAY TQ2-5 SV/1A 2pol vx 14X9X5m | 5322 280 20514 S |
| K5 | RELAY TQ2-5 SV/1A 2pol vx 14X9X5m | 5322 280 20514 S |
| K6 | RELAY TQ2-5 SV/1A 2pol vx 14X9X5m | 5322 280 20514 S |
| K7 | RELAY TQ2-5 SV/1A 2pol vx 14X9X5m | 5322 280 20514 S |
| K8 | RELAY TQ2-5 SV/1A 2pol vx 14X9X5m | 5322 280 20514 S |
| K9 | RELAY TQ2-5 SV/1A 2pol vx 14X9X5m | 5322 280 20514 S |
| L1 | CHOKE 220 µH 10% NL453232T-221K | 5322 157 61918 S |
| L10 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |

| Pos | Description | Part Number ☆ |
|-----|--|------------------|
| L11 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L12 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L13 | CHOKE 1µH 20% B82412-A1102-M | 2412 541 00458 S |
| L14 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L15 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L16 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L17 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L18 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L19 | CHOKE 33µH TSL0809-330K1R2 | 5322 157 53568 S |
| L20 | CHOKE 10mH B82722-J2102-N1 1A | 5322 157 70143 S |
| L21 | CHOKE 10.00µH NEWPORT 18R103 | 2422 536 00061 S |
| L22 | CHOKE 10.00µH NEWPORT 18R103 | 2422 536 00061 S |
| L23 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L24 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L25 | CHOKE 0.15µH 10% MLF3216DR15K | 5322 157 71041 S |
| L26 | CHOKE 0.15µH 10% MLF3216DR15K | 5322 157 71041 S |
| L27 | CHOKE 0.15µH 10% MLF3216DR15K | 5322 157 71041 S |
| L28 | CHOKE 0.10 µH 10% MLF3216DR10K | 5322 157 52986 S |
| L29 | CHOKE 0.15µH 10% MLF3216DR15K | 5322 157 71041 S |
| L3 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L30 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L31 | CHOKE 4.70µH 5% LQH1N4R7J | 2422 535 94048 S |
| L32 | CHOKE 4.70µH 5% LQH1N4R7J | 2422 535 94048 S |
| L33 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L39 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L4 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L40 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L41 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L42 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L43 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L45 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L46 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L47 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L48 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L49 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L5 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L50 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L51 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L52 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L53 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L54 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L55 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L56 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L57 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L58 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L59 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L60 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L61 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L62 | CHOKE 31 ohm CB50-321611T 1206 | 5322 157 61919 S |
| L7 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| L8 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |

| Pos | Description | Part Number ☆ |
|------|--|------------------|
| L9 | CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz | 5322 157 61928 S |
| P18 | FLAT PIN 2.8mm E184/8 LESA SN BAND | 5322 290 34064 S |
| P19 | FLAT PIN 2.8mm E184/8 LESA SN BAND | 5322 290 34064 S |
| P20 | CONNECTOR 16 POL TMH-108-01-L-DW | 5322 265 41013 S |
| P21 | CONNECTOR 10 POL 22-03-2101 4030-10A | 5322 265 64028 S |
| P24 | FLAT PIN 2.8mm E184/8 LESA SN BAND | 5322 290 34064 S |
| P25 | CONNECTOR 10 POL SINGLE ROW 90DEG | 4031 105 70790 S |
| P26 | FLAT PIN 2.8mm E184/8 LESA SN BAND | 5322 290 34064 S |
| P7 | CONNECTOR 3 POL F095 SINGLE ROW | 5322 290 60445 S |
| R10 | RESISTOR 100kohm 1% 0.125W 100PPM 1206 | 4822 051 51004 S |
| R100 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R101 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R102 | RESISTOR 82 ohm 1% .125W 100PPM 1206 | 4822 051 10829 S |
| R103 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R104 | RESISTOR 120 ohm 1% 0.125W 100PPM 1206 | 4822 051 10121 S |
| R105 | RESISTOR 120 ohm 1% 0.125W 100PPM 1206 | 4822 051 10121 S |
| R108 | RESISTOR 10 Mohm 10% 0.25W RC-01 1206 | 4822 051 10106 S |
| R109 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51002 S |
| R11 | RESISTOR 2.70kohm 1% .125W 100PPM 1206 | 4822 051 52702 S |
| R110 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R111 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R112 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51002 S |
| R113 | RESISTOR 10 Mohm 10% 0.25W RC-01 1206 | 4822 051 10106 S |
| R116 | RESISTOR 10.0 ohm 1% 0.125W 100PPM 1206 | 4822 051 10109 S |
| R118 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R12 | RESISTOR 1.80kohm 1% .125W 100PPM 1206 | 4822 051 10182 S |
| R124 | RESISTOR 10.0 ohm 1% 0.125W 100PPM 1206 | 4822 051 10109 S |
| R125 | RESISTOR 12.0kohm 1% .125W 100PPM 1206 | 5322 117 10968 S |
| R126 | RESISTOR 8.20kohm 1% .125W 100PPM 1206 | 4822 051 10822 S |
| R127 | RESISTOR 220.0ohm 1% .125W 100PPM 1206 | 4822 051 52201 S |
| R128 | RESISTOR 680 ohm 1% .125W 100PPM 1206 | 4822 051 56801 S |
| R129 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51002 S |
| R13 | RESISTOR 220.0ohm 1% .125W 100PPM 1206 | 4822 051 52201 S |
| R131 | RESISTOR 27.0 ohm 1% .125W 100PPM 1206 | 5322 116 82262 S |
| R132 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R133 | RESISTOR 27.0 ohm 1% .125W 100PPM 1206 | 5322 116 82262 S |
| R134 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R135 | RESISTOR 39 ohm 1% .125W 100PPM 1206 | 5322 116 82263 S |
| R136 | RESISTOR 39 ohm 1% .125W 100PPM 1206 | 5322 116 82263 S |
| R137 | RESISTOR 39 ohm 1% .125W 100PPM 1206 | 5322 116 82263 S |
| R138 | RESISTOR 39 ohm 1% .125W 100PPM 1206 | 5322 116 82263 S |
| R139 | RESISTOR 39 ohm 1% .125W 100PPM 1206 | 5322 116 82263 S |
| R14 | RESISTOR 1.60kohm 1% 0.125W 100PPM 1206 | 4822 051 51502 S |
| R140 | RESISTOR 39 ohm 1% .125W 100PPM 1206 | 5322 116 82263 S |
| R141 | RESISTOR 39 ohm 1% .125W 100PPM 1206 | 5322 116 82263 S |
| R142 | RESISTOR 39 ohm 1% .125W 100PPM 1206 | 5322 116 82263 S |
| R143 | RESISTOR 39 ohm 1% .125W 100PPM 1206 | 5322 116 82263 S |
| R144 | RESISTOR 33.0 ohm 1% .125W 100PPM 1206 | 4822 051 10339 S |
| R145 | RESISTOR 33.0 ohm 1% .125W 100PPM 1206 | 4822 051 10339 S |
| R146 | RESISTOR 33.0 ohm 1% .125W 100PPM 1206 | 4822 051 10339 S |
| R147 | RESISTOR 39 ohm 1% .125W 100PPM 1206 | 5322 116 82263 S |
| R148 | RESISTOR 39 ohm 1% .125W 100PPM 1206 | 5322 116 82263 S |
| R149 | RESISTOR 39 ohm 1% .125W 100PPM 1206 | 5322 116 82263 S |
| R15 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51002 S |
| R150 | RESISTOR 39 ohm 1% .125W 100PPM 1206 | 5322 116 82263 S |
| R151 | RESISTOR 39 ohm 1% .125W 100PPM 1206 | 5322 116 82263 S |
| R152 | RESISTOR 39 ohm 1% .125W 100PPM 1206 | 5322 116 82263 S |
| R153 | RESISTOR 39 ohm 1% .125W 100PPM 1206 | 5322 116 82263 S |
| R154 | RESISTOR 39 ohm 1% .125W 100PPM 1206 | 5322 116 82263 S |
| R155 | RESISTOR 39 ohm 1% .125W 100PPM 1206 | 5322 116 82263 S |
| R156 | RESISTOR 33.0 ohm 1% .125W 100PPM 1206 | 4822 051 10339 S |
| R157 | RESISTOR 33.0 ohm 1% .125W 100PPM 1206 | 4822 051 10339 S |
| R158 | RESISTOR 33.0 ohm 1% .125W 100PPM 1206 | 4822 051 10339 S |
| R16 | RESISTOR 470.0Kohm 0.5% 0.125W RC-03G | 5322 117 10858 S |
| R161 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R162 | RESISTOR 47 ohm 1% .125W 100PPM 1206 | 5322 116 80448 S |
| R163 | RESISTOR 82 ohm 1% .125W 100PPM 1206 | 4822 051 10829 S |
| R164 | RESISTOR 82 ohm 1% .125W 100PPM 1206 | 4822 051 10829 S |
| R165 | RESISTOR 330 ohm 1% .125W 100PPM 1206 | 4822 051 53301 S |
| R166 | RESISTOR 10.0 ohm 1% 0.125W 100PPM 1206 | 4822 051 10109 S |
| R167 | POTENTIOMETER 100kohm 20% 3362P-1-104 | 2122 362 01083 S |
| R168 | POTENTIOMETER 100kohm 20% 3362P-1-104 | 2122 362 01083 S |
| R169 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R17 | RESISTOR 470.0Kohm 0.5% 0.125W RC-03G | 5322 117 10858 S |
| R170 | RESISTOR 330 ohm 1% .125W 100PPM 1206 | 4822 051 53301 S |
| R171 | RESISTOR 560 ohm 1% .125W 100PPM 1206 | 4822 051 10561 S |
| R172 | RESISTOR 2.20kohm 1% .125W 100PPM 1206 | 4822 051 52202 S |
| R173 | RESISTOR 2.20kohm 1% .125W 100PPM 1206 | 4822 051 52202 S |
| R174 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51004 S |
| R175 | RESISTOR 100kohm 1% 0.125W 100PPM 1206 | 4822 051 51004 S |
| R176 | RESISTOR 100kohm 1% 0.125W 100PPM 1206 | 4822 051 51004 S |
| R177 | RESISTOR 100kohm 1% 0.125W 100PPM 1206 | 4822 051 51004 S |
| R178 | RESISTOR 100kohm 1% 0.125W 100PPM 1206 | 4822 051 51004 S |
| R179 | RESISTOR 100kohm 1% 0.125W 100PPM 1206 | 4822 051 51004 S |
| R18 | POTENTIOMETER 20kohm 10% 3323P-1-203-10 | 5322 101 11074 S |
| R180 | RESISTOR 100kohm 1% 0.125W 100PPM 1206 | 4822 051 51004 S |
| R181 | RESISTOR 100kohm 1% 0.125W 100PPM 1206 | 4822 051 51004 S |
| R182 | RESISTOR 100kohm 1% 0.125W 100PPM 1206 | 4822 051 51004 S |
| R183 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R184 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R185 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R186 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R187 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R188 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R189 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R19 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R190 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R191 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R192 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R193 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |

| Pos | Description | Part Number ☆ |
|------|---|------------------|
| R194 | RESISTOR 39.0kohm 1% .125W 100PPM 1206 | 4822 051 53903 S |
| R195 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R196 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R197 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R198 | RESISTOR 220.0ohm 1% .125W 100PPM 1206 | 4822 051 52201 S |
| R199 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R20 | RESISTOR 390 ohm 1% .125W 100PPM 1206 | 4822 051 53901 S |
| R200 | RESISTOR 47 ohm 1% .125W 100PPM 1206 | 5322 116 80448 S |
| R201 | RESISTOR 47 ohm 1% .125W 100PPM 1206 | 5322 116 80448 S |
| R202 | RESISTOR 47 ohm 1% .125W 100PPM 1206 | 5322 116 80448 S |
| R203 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R204 | RESISTOR 100kohm 1% 0.125W 100PPM 1206 | 4822 051 51004 S |
| R206 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R207 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R208 | RESISTOR 47 ohm 1% .125W 100PPM 1206 | 5322 116 80448 S |
| R209 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R21 | RESISTOR 390 ohm 1% .125W 100PPM 1206 | 4822 051 53901 S |
| R210 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R211 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R212 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R217 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51002 S |
| R22 | RESISTOR 470.0Kohm 0.5% 0.125W RC-03G | 5322 117 10858 S |
| R220 | RESISTOR 820 ohm 1% .125W 100PPM 1206 | 5322 116 82264 S |
| R221 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R222 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R223 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R224 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R225 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R226 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R227 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R228 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R229 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R23 | RESISTOR 470.0Kohm 0.5% 0.125W RC-03G | 5322 117 10858 S |
| R230 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R231 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R232 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R233 | RESISTOR 270 ohm 1% .125W 100PPM 1206 | 4822 051 10271 S |
| R234 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R235 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R236 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R237 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51002 S |
| R238 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R239 | RESISTOR 1.00Mohm 1% 0.125W 100PPM 1206 | 4822 051 10105 S |
| R24 | RESISTOR 15.0Kohm 1% .125W 100PPM 1206 | 5322 116 82261 S |
| R240 | RESISTOR 560 ohm 1% .125W 100PPM 1206 | 4822 051 10561 S |
| R241 | RESISTOR 1.50kohm 1% 0.125W 100PPM 1206 | 4822 051 51502 S |
| R242 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R243 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R244 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R245 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R246 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51002 S |
| R247 | RESISTOR 68 ohm 1% .125W 100PPM 1206 | 4822 051 10689 S |
| R248 | RESISTOR 68 ohm 1% .125W 100PPM 1206 | 4822 051 10689 S |
| R249 | RESISTOR 15.0Kohm 1% .125W 100PPM 1206 | 5322 116 82261 S |
| R25 | RESISTOR 330 ohm 1% .125W 100PPM 1206 | 4822 051 53301 S |
| R250 | RESISTOR 15.0Kohm 1% .125W 100PPM 1206 | 5322 116 82261 S |
| R251 | RESISTOR 560 ohm 1% .125W 100PPM 1206 | 4822 051 10561 S |
| R252 | RESISTOR 4.70kohm 1% .125W 100PPM 1206 | 4822 051 54702 S |
| R253 | RESISTOR 120 ohm 1% 0.125W 100PPM 1206 | 4822 051 10121 S |
| R254 | RESISTOR 47 ohm 1% .125W 100PPM 1206 | 5322 116 80448 S |
| R255 | RESISTOR 4.70kohm 1% .125W 100PPM 1206 | 4822 051 54702 S |
| R256 | RESISTOR 270 ohm 1% .125W 100PPM 1206 | 4822 051 10271 S |
| R257 | RESISTOR 150 ohm 1% 0.125W 100PPM 1206 | 4822 051 51501 S |
| R258 | RESISTOR 1.50kohm 1% 0.125W 100PPM 1206 | 4822 051 51502 S |
| R259 | RESISTOR 470 ohm 1% .125W 100PPM 1206 | 4822 051 54701 S |
| R26 | RESISTOR 330 ohm 1% .125W 100PPM 1206 | 4822 051 53301 S |
| R260 | RESISTOR 470 ohm 1% .125W 100PPM 1206 | 4822 051 54701 S |
| R261 | RESISTOR 47 ohm 1% .125W 100PPM 1206 | 5322 116 80448 S |
| R263 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51002 S |
| R264 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R265 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R266 | RESISTOR 27.0 ohm 1% .125W 100PPM 1206 | 5322 116 82262 S |
| R269 | RESISTOR 3.30kohm 1% .125W 100PPM 1206 | 4822 051 53302 S |
| R27 | RESISTOR 470.0Kohm 0.5% 0.125W RC-03G | 5322 117 10858 S |
| R270 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R271 | RESISTOR 47 ohm 1% .125W 100PPM 1206 | 5322 116 80448 S |
| R273 | RESISTOR 22 ohm 1% .125W 100PPM 1206 | 4822 051 10229 S |
| R274 | RESISTOR 22 ohm 1% .125W 100PPM 1206 | 4822 051 10229 S |
| R276 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51002 S |
| R277 | RESISTOR 180.0ohm 1% .125W 100PPM 1206 | 4822 051 10181 S |
| R278 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51002 S |
| R279 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51002 S |
| R28 | RESISTOR 56.0kohm 1% .125W 100PPM 1206 | 532 |

| Pos | Description | Part Number ☆ |
|------|--|------------------|
| R298 | RESISTOR 220.0ohm 1% .125W 100PPM 1206 | 4822 051 52201 S |
| R299 | RESISTOR 6.80kohm 1% .125W 100PPM 1206 | 4822 051 10682 S |
| R30 | RESISTOR 47.0kohm 0.5% 0.125W RC-03G 1206 | 5322 117 10857 S |
| R300 | RESISTOR 6.80kohm 1% .125W 100PPM 1206 | 4822 051 10682 S |
| R301 | RESISTOR 820 ohm 1% .125W 100PPM 1206 | 5322 116 82264 S |
| R302 | RESISTOR 820 ohm 1% .125W 100PPM 1206 | 5322 116 82264 S |
| R303 | RESISTOR 150 ohm 1% 0.125W 100PPM 1206 | 4822 051 51501 S |
| R304 | RESISTOR 150 ohm 1% 0.125W 100PPM 1206 | 4822 051 51501 S |
| R305 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R306 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R307 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R308 | POTENTIOMETER 20kohm 10% 3323P-1-203-10 | 5322 101 11074 S |
| R309 | RESISTOR 68.0kohm 1% .125W 100PPM 1206 | 4822 051 56803 S |
| R31 | RESISTOR 330 kohm 1% .125W 100PPM 1206 | 5322 117 10969 S |
| R310 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R311 | POTENTIOMETER 20kohm 10% 3323P-1-203-10 | 5322 101 11074 S |
| R312 | RESISTOR 68.0kohm 1% .125W 100PPM 1206 | 4822 051 56803 S |
| R313 | RESISTOR 3.30kohm 1% .125W 100PPM 1206 | 4822 051 53302 S |
| R314 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R316 | RESISTOR 3.30kohm 1% .125W 100PPM 1206 | 4822 051 53302 S |
| R317 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R319 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R32 | RESISTOR 470.0Kohm 0.5% 0.125W RC-03G 1206 | 5322 117 10858 S |
| R320 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R321 | 10 Kohm 0.1% 0.25W MPR24 | 5322 116 82868 S |
| R322 | 10 Kohm 0.1% 0.25W MPR24 | 5322 116 82868 S |
| R323 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R324 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R325 | RESISTOR 680 ohm 1% .125W 100PPM 1206 | 4822 051 56801 S |
| R326 | RESISTOR 680 ohm 1% .125W 100PPM 1206 | 4822 051 56801 S |
| R327 | RESISTOR 680 ohm 1% .125W 100PPM 1206 | 4822 051 56801 S |
| R328 | RESISTOR 0 ohm BYGLING RC-01 1206 | 4822 051 10008 S |
| R329 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R330 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R331 | POTENTIOMETER 20kohm 10% 3323P-1-203-10 | 5322 101 11074 S |
| R332 | RESISTOR 22.0kohm 1% .125W 100PPM 1206 | 4822 051 52203 S |
| R334 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R335 | RESISTOR 180.0ohm 1% .125W 100PPM 1206 | 4822 051 10181 S |
| R336 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51002 S |
| R337 | THERMISTOR 16.0ohm 20% 3.5A S236/16 | 5322 116 30457 S |
| R339 | RESISTOR 180.0ohm 1% .125W 100PPM 1206 | 4822 051 10181 S |
| R34 | RESISTOR 56.0kohm 1% .125W 100PPM 1206 | 5322 117 10971 S |
| R340 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R341 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R342 | RESISTOR 470 ohm 1% .125W 100PPM 1206 | 4822 051 54701 S |
| R344 | RESISTOR 2.20kohm 1% .125W 100PPM 1206 | 4822 051 52202 S |
| R345 | RESISTOR 15.0Kohm 1% .125W 100PPM 1206 | 5322 116 82261 S |
| R346 | RESISTOR 470.0Kohm 0.5% 0.125W RC-03G 1206 | 5322 117 10858 S |
| R347 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R348 | RESISTOR 100kohm 1% 0.125W 100PPM 1206 | 4822 051 51004 S |
| R349 | RESISTOR 220.0ohm 1% .125W 100PPM 1206 | 4822 051 52201 S |
| A | | |
| R349 | RESISTOR 220.0ohm 1% .125W 100PPM 1206 | 4822 051 52201 S |
| B | | |
| R349 | RESISTOR 220.0ohm 1% .125W 100PPM 1206 | 4822 051 52201 S |
| C | | |
| R349 | RESISTOR 220.0ohm 1% .125W 100PPM 1206 | 4822 051 52201 S |
| D | | |
| R349 | RESISTOR 220.0ohm 1% .125W 100PPM 1206 | 4822 051 52201 S |
| E | | |
| R35 | RESISTOR 470.0Kohm 0.5% 0.125W RC-03G 1206 | 5322 117 10858 S |
| R350 | RESISTOR 15.0Kohm 1% .125W 100PPM 1206 | 5322 116 82261 S |
| R352 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51002 S |
| R353 | RESISTOR 0.22 ohm 5% 0.125W LRC01 3.2x1.6 | 5322 117 11786 S |
| R354 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R355 | RESISTOR 1.00Mohm 1% 0.125W 100PPM 1206 | 4822 051 10105 S |
| R356 | RESISTOR 100kohm 1% 0.125W 100PPM 1206 | 4822 051 51004 S |
| R357 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R358 | RESISTOR 33.0kohm 1% .125W 100PPM 1206 | 4822 051 53303 S |
| R359 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R36 | RESISTOR 100kohm 1% 0.125W 100PPM 1206 | 4822 051 51004 S |
| R360 | RESISTOR 1.80kohm 1% .125W 100PPM 1206 | 4822 051 10182 S |
| R361 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51002 S |
| R365 | RESISTOR 560 ohm 1% .125W 100PPM 1206 | 4822 051 10561 S |
| R366 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51002 S |
| R367 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51002 S |
| R368 | RESISTOR 82 ohm 1% .125W 100PPM 1206 | 4822 051 10829 S |
| R369 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R37 | RESISTOR 2.70kohm 1% .125W 100PPM 1206 | 4822 051 52702 S |
| R370 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R371 | RESISTOR 100kohm 1% 0.125W 100PPM 1206 | 4822 051 51004 S |
| R372 | RESISTOR 390 ohm 1% .125W 100PPM 1206 | 4822 051 53901 S |
| R373 | RESISTOR 560 ohm 1% .125W 100PPM 1206 | 4822 051 10561 S |
| R374 | RESISTOR 2.20kohm 1% .125W 100PPM 1206 | 4822 051 52202 S |
| R375 | RESISTOR 560 ohm 1% .125W 100PPM 1206 | 4822 051 10561 S |
| R377 | RESISTOR 4.70kohm 1% .125W 100PPM 1206 | 4822 051 54702 S |
| R378 | RESISTOR 4.70kohm 1% .125W 100PPM 1206 | 4822 051 54702 S |
| R379 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R38 | RESISTOR 1.80kohm 1% .125W 100PPM 1206 | 4822 051 10182 S |
| R380 | RESISTOR 4.70kohm 1% .125W 100PPM 1206 | 4822 051 54702 S |
| R381 | POTENTIOMETER 1kohm 20% 3323P-1-102 | 4822 101 10792 S |
| R382 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R383 | RESISTOR 330 ohm 1% .125W 100PPM 1206 | 4822 051 53301 S |
| R384 | POTENTIOMETER 20kohm 10% 3323P-1-203-10 | 5322 101 11074 S |
| R385 | RESISTOR 3.30kohm 1% .125W 100PPM 1206 | 4822 051 53302 S |
| R386 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R387 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R388 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51002 S |

| Pos | Description | Part Number ☆ |
|------|--|------------------|
| R39 | RESISTOR 220.0ohm 1% .125W 100PPM 1206 | 4822 051 52201 S |
| R4 | RESISTOR 47.0kohm 0.5% 0.125W RC-03G 1206 | 5322 117 10857 S |
| R40 | RESISTOR 1.50kohm 1% 0.125W 100PPM 1206 | 4822 051 51502 S |
| R402 | RESISTOR 47 ohm 1% .125W 100PPM 1206 | 5322 116 80448 S |
| R403 | RESISTOR 820 ohm 1% .125W 100PPM 1206 | 5322 116 82264 S |
| R404 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R405 | FILTER-EMI BLM31A601SPT Z=600ohm 0.2A 1206 | 2422 549 42404 S |
| R407 | RESISTOR 330 ohm 1% .125W 100PPM 1206 | 4822 051 53301 S |
| R409 | RESISTOR 100kohm 1% 0.125W 100PPM 1206 | 4822 051 51004 S |
| R41 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51002 S |
| R42 | RESISTOR 470.0Kohm 0.5% 0.125W RC-03G 1206 | 5322 117 10858 S |
| R426 | RESISTOR 680 ohm 1% .125W 100PPM 1206 | 4822 051 56801 S |
| R427 | RESISTOR 680 ohm 1% .125W 100PPM 1206 | 4822 051 56801 S |
| R428 | RESISTOR 470.0Kohm 0.5% 0.125W RC-03G 1206 | 5322 117 10858 S |
| R429 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R43 | RESISTOR 470.0Kohm 0.5% 0.125W RC-03G 1206 | 5322 117 10858 S |
| R430 | RESISTOR 47 ohm 1% .125W 100PPM 1206 | 5322 116 80448 S |
| R431 | RESISTOR 27.0 ohm 1% .125W 100PPM 1206 | 5322 116 82262 S |
| R432 | RESISTOR 82 ohm 1% .125W 100PPM 1206 | 4822 051 10829 S |
| R433 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51002 S |
| R435 | RESISTOR 82 ohm 1% .125W 100PPM 1206 | 4822 051 10829 S |
| R436 | RESISTOR 82 ohm 1% .125W 100PPM 1206 | 4822 051 10829 S |
| R437 | RESISTOR 270 ohm 1% .125W 100PPM 1206 | 4822 051 10271 S |
| R438 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R439 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R44 | POTENTIOMETER 20kohm 10% 3323P-1-203-10 | 5322 101 11074 S |
| R440 | RESISTOR 2.20kohm 1% .125W 100PPM 1206 | 4822 051 52202 S |
| R441 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51002 S |
| R442 | RESISTOR 1.80kohm 1% .125W 100PPM 1206 | 4822 051 10182 S |
| R443 | RESISTOR 3.90kohm 1% .125W 100PPM 1206 | 4822 051 53902 S |
| R444 | RESISTOR 47.0kohm 0.5% 0.125W RC-03G 1206 | 5322 117 10857 S |
| R445 | RESISTOR 220 kohm 1% .125W 100PPM 1206 | 4822 051 52204 S |
| R446 | POTENTIOMETER 1kohm 20% 3323P-1-102 | 4822 101 10792 S |
| R447 | RESISTOR 3.30kohm 1% .125W 100PPM 1206 | 4822 051 53302 S |
| R448 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R449 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R45 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R450 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R451 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R452 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R453 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R454 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R455 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R456 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R46 | RESISTOR 390 ohm 1% .125W 100PPM 1206 | 4822 051 53901 S |
| R460 | RESISTOR 100kohm 1% 0.125W 100PPM 1206 | 4822 051 51004 S |
| R461 | RESISTOR 100kohm 1% 0.125W 100PPM 1206 | 4822 051 51004 S |
| R462 | RESISTOR 100kohm 1% 0.125W 100PPM 1206 | 4822 051 51004 S |
| R463 | RESISTOR 100kohm 1% 0.125W 100PPM 1206 | 4822 051 51004 S |
| R464 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R465 | RESISTOR 4.7 ohm 10% 0.25W RC-01 1206 | 4833 051 10478 S |
| R466 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R467 | RESISTOR 100kohm 1% 0.125W 100PPM 1206 | 4822 051 51004 S |
| R468 | RESISTOR 100kohm 1% 0.125W 100PPM 1206 | 4822 051 51004 S |
| R469 | RESISTOR 10.0 ohm 1% 0.125W 100PPM 1206 | 4822 051 10109 S |
| R47 | RESISTOR 390 ohm 1% .125W 100PPM 1206 | 4822 051 53901 S |
| R470 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51002 S |
| R471 | RESISTOR 2.7ohm 5% 0.25W RC-01 1206 | 4822 051 10278 S |
| R472 | RESISTOR 2.7ohm 5% 0.25W RC-01 1206 | 4822 051 10278 S |
| R473 | RESISTOR 2.7ohm 5% 0.25W RC-01 1206 | 4822 051 10278 S |
| R474 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51002 S |
| R475 | RESISTOR 10.0 ohm 1% 0.125W 100PPM 1206 | 4822 051 10109 S |
| R476 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R477 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R478 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51002 S |
| R479 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R48 | RESISTOR 470.0Kohm 0.5% 0.125W RC-03G 1206 | 5322 117 10858 S |
| R480 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R481 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51002 S |
| R482 | VARIATOR 95V 95VRMS4.1J | 5322 116 21222 S |
| R483 | RESISTOR 4.70kohm 1% .125W 100PPM 1206 | 4822 051 54702 S |
| R484 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R485 | RESISTOR 22.0kohm 1% .125W 100PPM 1206 | 4822 051 52203 S |
| R486 | RESISTOR 8.20kohm 1% .125W 100PPM 1206 | 4822 051 10822 S |
| R488 | RESISTOR 150 ohm 1% 0.1W 100PPM 0805 | 4031 002 15010 S |
| B | | |
| R489 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51002 S |
| R49 | RESISTOR 470.0Kohm 0.5% 0.125W RC-03G 1206 | 5322 117 10858 S |
| R491 | RESISTOR 2.20kohm 1% .125W 100PPM 1206 | 4822 051 52202 S |
| R492 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R493 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R494 | RESISTOR 2.20kohm 1% .125W 100PPM 1206 | 4822 051 52202 S |
| R495 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R496 | RESISTOR 47 ohm 1% .125W 100PPM 1206 | 5322 116 80448 S |
| R497 | RESISTOR 33.0 ohm 1% .125W 100PPM 1206 | 4822 051 10339 S |
| R498 | RESISTOR 47 ohm 1% .125W 100PPM 1206 | 5322 116 80448 S |
| R499 | RESISTOR 33.0 ohm 1% .125W 100PPM 1206 | 4822 051 10339 S |
| R5 | RESISTOR 330 kohm 1% .125W 100PPM 1206 | 5322 117 10969 S |
| R50 | RESISTOR 15.0Kohm 1% .125W 100PPM 1206 | 5322 116 82261 S |
| R500 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R501 | RESISTOR 2.20kohm 1% .125W 100PPM 1206 | 4822 051 52202 S |
| R502 | RESISTOR 2.20kohm 1% .125W 100PPM 1206 | 4822 051 52202 S |
| R503 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R504 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R508 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |

| Pos | Description | Part Number ☆ |
|------|--|------------------|
| R51 | RESISTOR 330 ohm 1% .125W 100PPM 1206 | 4822 051 53301 S |
| R514 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R515 | RESISTOR 33.0 ohm 1% .125W 100PPM 1206 | 4822 051 10339 S |
| R516 | RESISTOR 33.0 ohm 1% .125W 100PPM 1206 | 4822 051 10339 S |
| R517 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R518 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R519 | RESISTOR 33.0 ohm 1% .125W 100PPM 1206 | 4822 051 10339 S |
| R52 | RESISTOR 470.0Kohm 0.5% 0.125W RC-03G 1206 | 5322 117 10858 S |
| R520 | RESISTOR 33.0 ohm 1% .125W 100PPM 1206 | 4822 051 10339 S |
| R521 | RESISTOR 10.0 ohm 1% 0.125W 100PPM 1206 | 4822 051 10109 S |
| R522 | RESISTOR 100kohm 1% 0.125W 100PPM 1206 | 4822 051 51004 S |
| R523 | RESISTOR 33.0 ohm 1% .125W 100PPM 1206 | 4822 051 10339 S |
| R524 | RESISTOR 2.20kohm 1% .125W 100PPM 1206 | 4822 051 52202 S |
| R525 | RESISTOR 220.0ohm 1% .125W 100PPM 1206 | 4822 051 52201 S |
| R527 | RESISTOR 33.0 ohm 1% .125W 100PPM 1206 | 4822 051 10339 S |
| R528 | RESISTOR 47 ohm 1% .125W 100PPM 1206 | 5322 116 80448 S |
| R529 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R53 | RESISTOR 56.0kohm 1% .125W 100PPM 1206 | 5322 117 10971 S |
| R530 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R531 | RESISTOR 47 ohm 1% .125W 100PPM 1206 | 5322 116 80448 S |
| R535 | RESISTOR 47 ohm 1% .125W 100PPM 1206 | 5322 116 80448 S |
| R536 | RESISTOR 47 ohm 1% .125W 100PPM 1206 | 5322 116 80448 S |
| R537 | RESISTOR 120 ohm 1% 0.125W 100PPM 1206 | 4822 051 10121 S |
| R538 | RESISTOR 33.0 ohm 1% .125W 100PPM 1206 | 4822 051 10339 S |
| R54 | RESISTOR 470.0Kohm 0.5% 0.125W RC-03G 1206 | 5322 117 10858 S |
| R544 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51002 S |
| R545 | RESISTOR 47.0kohm 0.5% 0.125W RC-03G 1206 | 5322 117 10857 S |
| R546 | RESISTOR 33.0 ohm 1% .125W 100PPM 1206 | 4822 051 10339 S |
| R547 | RESISTOR 47 ohm 1% .125W 100PPM 1206 | 5322 116 80448 S |
| R548 | RESISTOR 330 kohm 1% .125W 100PPM 1206 | 5322 117 10969 S |
| R549 | RESISTOR 330 kohm 1% .125W 100PPM 1206 | 5322 117 10969 S |
| R55 | RESISTOR 150 ohm 1% 0.125W 100PPM 1206 | 4822 051 51501 S |
| R550 | RESISTOR 18.0kohm 1% .125W 100PPM 1206 | 5322 117 10034 S |
| R551 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R552 | RESISTOR 2.20kohm 1% .125W 100PPM 1206 | 4822 051 52202 S |
| R553 | RESISTOR 2.20kohm 1% .125W 100PPM 1206 | 4822 051 52202 S |
| R555 | RESISTOR 10 Mohm 10% 0.25W RC-01 1206 | 4822 051 10106 S |
| R556 | RESISTOR 47.0kohm 0.5% 0.125W RC-03G 1206 | 5322 117 10857 S |
| R557 | RESISTOR 4.70kohm 1% .125W 100PPM 1206 | 4822 051 54702 S |
| R558 | RESISTOR 2.7ohm 5% 0.25W RC-01 1206 | 4822 051 10278 S |
| R559 | RESISTOR 47 ohm 1% .125W 100PPM 1206 | 5322 116 80448 S |
| R56 | RESISTOR 33.0 ohm 1% .125W 100PPM 1206 | 4822 051 10339 S |
| R560 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R561 | RESISTOR 270 ohm 1% .125W 100PPM 1206 | 4822 051 10271 S |
| R562 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R563 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R564 | THERMISTOR 2.2Kohm 3% 0.25W NTC | 5322 116 30458 S |
| R566 | RESISTOR 100kohm 1% 0.125W 100PPM 1206 | 4822 051 51004 S |
| R567 | RESISTOR 100kohm 1% 0.125W 100PPM 1206 | 4822 051 51004 S |
| R568 | RESISTOR 47 ohm 1% .125W 100PPM 1206 | 5322 116 80448 S |
| R569 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R57 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R570 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R571 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R574 | RESISTOR 100kohm 1% 0.125W 100PPM 1206 | 4822 051 51004 S |
| R577 | RESISTOR 220.0ohm 1% .125W 100PPM 1206 | 4822 051 52201 S |
| R578 | RESISTOR 220.0ohm 1% .125W 100PPM 1206 | 4822 051 52201 S |
| R579 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51002 S |
| R58 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R580 | RESISTOR 3.30kohm 1% .125W 100PPM 1206 | 4822 051 53302 S |
| R581 | RESISTOR 4.70kohm 1% .125W 100PPM 1206 | 4822 051 54702 S |
| R582 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R583 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51002 S |
| R584 | RESISTOR 100kohm 1% 0.125W 100PPM 1206 | 4822 051 51004 S |
| R585 | RESISTOR 33.0 ohm 1% .125W 100PPM 1206 | 4822 051 10339 S |
| R586 | RESISTOR 33.0 ohm 1% .125W 100PPM 1206 | 4822 051 10339 S |
| R587 | THERMISTOR 2.2Kohm 3% 0.25W NTC | 5322 116 30458 S |
| R588 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R589 | RESISTOR 1.00Mohm 1% 0.125W 100PPM 1206 | 4822 051 10105 S |
| R59 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R590 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51002 S |
| R591 | RESISTOR 100 ohm 1% 0.1W 100PPM 0805 | 5322 117 12497 S |
| R592 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R593 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51002 S |
| R594 | RESISTOR 820 ohm 1% .125W 100PPM 1206 | 5322 116 82264 S |
| R595 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R598 | RESISTOR 47 ohm 1% .125W 100PPM 1206 | 5322 116 80448 S |
| R599 | RESISTOR 2.20kohm 1% .125W 100PPM 1206 | 4822 051 52202 S |
| R6 | RESISTOR 470.0Kohm 0.5% 0.125W RC-03G 1206 | 5322 117 10858 S |
| R60 | RESISTOR 470 ohm 1% .125W 100PPM 1206 | 4822 051 54701 S |
| R600 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R601 | RESISTOR 33.0 ohm 1% .125W 100PPM 1206 | 4822 051 10339 S |
| R602 | RESISTOR 100kohm 1% 0.125W 100PPM 1206 | 4822 051 51004 S |
| R603 | RESISTOR 100kohm 1% 0.125W 100PPM 1206 | 4822 051 51004 S |
| R604 | RESISTOR 33.0 ohm 1% .125W 100PPM 1206 | 4822 051 10339 S |
| R605 | RESISTOR 100kohm 1% 0.125W 100PPM 1206 | 4822 051 51004 S |
| R606 | RESISTOR 100kohm 1% 0.125W 100PPM 1206 | 4822 051 51004 S |
| R607 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R608 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R609 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R61 | RESISTOR 390 ohm 1% .125W 100PPM 1206 | 4822 051 53901 S |
| R610 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R611 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R612 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R613 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R614 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |
| R615 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R616 | RESISTOR 56 ohm 1% .125W 100PPM 1206 | 4822 051 10569 S |

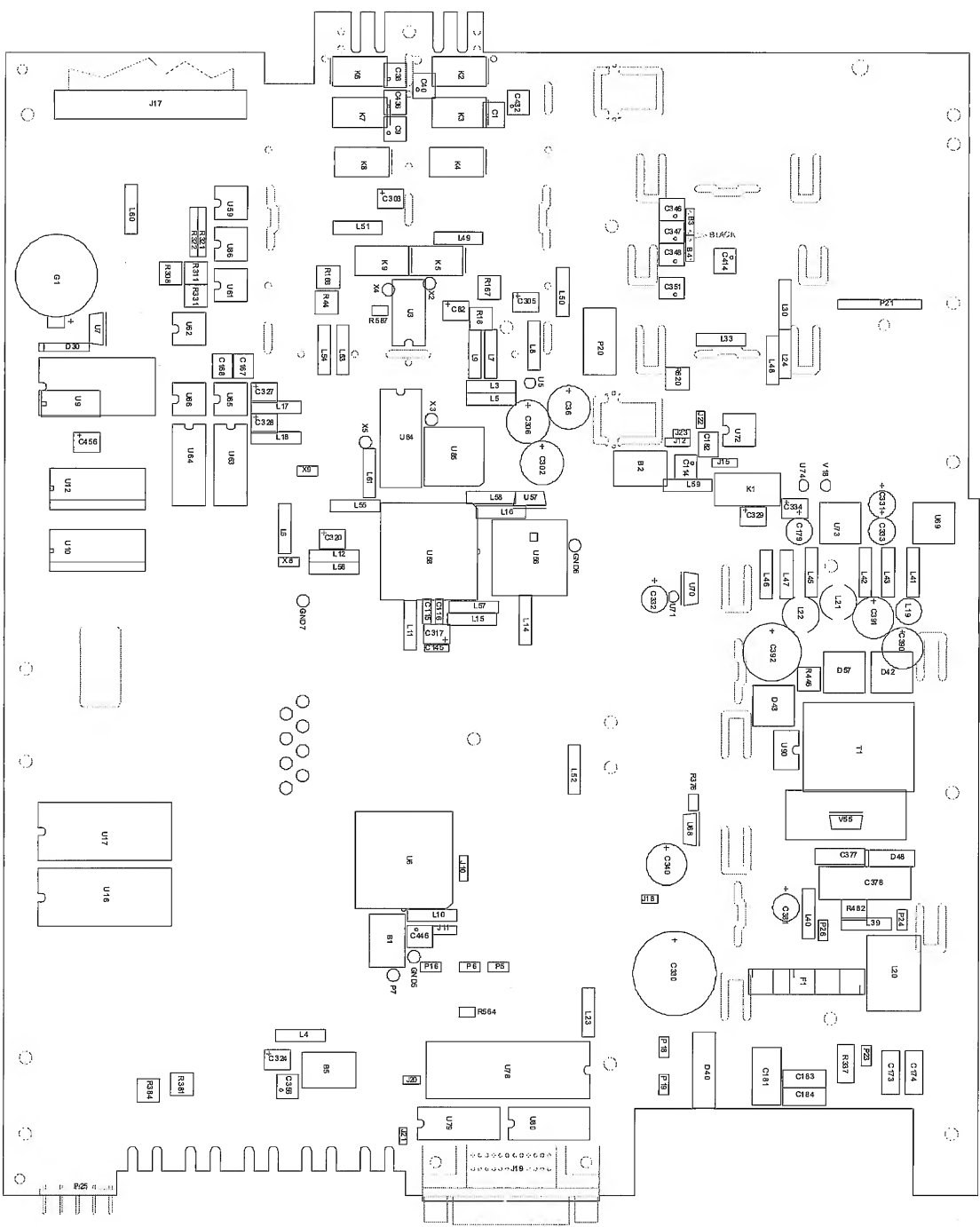
| Pos | Description | Part Number ☆ |
|------|--|------------------|
| R617 | RESISTOR 47 ohm 1% .125W 100PPM 1206 | 5322 116 80448 S |
| R618 | RESISTOR 2.20kohm 1% .125W 100PPM 1206 | 4822 051 52202 S |
| R619 | RESISTOR 68.0kohm 1% .125W 100PPM 1206 | 4822 051 56803 S |
| R62 | RESISTOR 390 ohm 1% .125W 100PPM 1206 | 4822 051 53901 S |
| R620 | POTENTIOMETER 20kohm 10% 3323P-1-203-10 | 5322 101 11074 S |
| R621 | RESISTOR 68.0kohm 1% .125W 100PPM 1206 | 4822 051 56803 S |
| R622 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R623 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R624 | RESISTOR 100 ohm 1% 0.1W 100PPM 0805 | 5322 117 12497 S |
| R625 | RESISTOR 100 ohm 1% 0.1W 100PPM 0805 | 5322 117 12497 S |
| R626 | RESISTOR 100 ohm 1% 0.1W 100PPM 0805 | 5322 117 12497 S |
| R63 | RESISTOR 220.0ohm 1% .125W 100PPM 1206 | 4822 051 52201 S |
| R64 | RESISTOR 68 ohm 1% .125W 100PPM 1206 | 4822 051 10689 S |
| R65 | RESISTOR 68 ohm 1% .125W 100PPM 1206 | 4822 051 10689 S |
| R66 | RESISTOR 47 ohm 1% .125W 100PPM 1206 | 5322 116 80448 S |
| R67 | RESISTOR 47 ohm 1% .125W 100PPM 1206 | 5322 116 80448 S |
| R68 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51002 S |
| R69 | RESISTOR 82 ohm 1% .125W 100PPM 1206 | 4822 051 10829 S |
| R7 | RESISTOR 56.0kohm 1% .125W 100PPM 1206 | 5322 117 10971 S |
| R70 | RESISTOR 150 ohm 1% 0.125W 100PPM 1206 | 4822 051 51501 S |
| R71 | RESISTOR 33.0 ohm 1% .125W 100PPM 1206 | 4822 051 10339 S |
| R72 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R73 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R74 | RESISTOR 10.0kohm 1% 0.125W 100PPM 1206 | 4822 051 51003 S |
| R75 | RESISTOR 470 ohm 1% .125W 100PPM 1206 | 4822 051 54701 S |
| R76 | RESISTOR 390 ohm 1% .125W 100PPM 1206 | 4822 051 53901 S |
| R77 | RESISTOR 390 ohm 1% .125W 100PPM 1206 | 4822 051 53901 S |
| R78 | RESISTOR 220.0ohm 1% .125W 100PPM 1206 | 4822 051 52201 S |
| R79 | RESISTOR 68 ohm 1% .125W 100PPM 1206 | 4822 051 10689 S |
| R8 | RESISTOR 470.0Kohm 0.5% 0.125W RC-03G 1206 | 5322 117 10858 S |
| R80 | RESISTOR 68 ohm 1% .125W 100PPM 1206 | 4822 051 10689 S |
| R81 | RESISTOR 47 ohm 1% .125W 100PPM 1206 | 5322 116 80448 S |
| R82 | RESISTOR 47 ohm 1% .125W 100PPM 1206 | 5322 116 80448 S |
| R83 | RESISTOR 1.00kohm 1% 0.125W 100PPM 1206 | 4822 051 51002 S |
| R84 | RESISTOR 82 ohm 1% .125W 100PPM 1206 | 4822 051 10829 S |
| R85 | RESISTOR 47 ohm 1% .125W 100PPM 1206 | 5322 116 80448 S |
| R86 | RESISTOR 47 ohm 1% .125W 100PPM 1206 | 5322 116 80448 S |
| R87 | RESISTOR 82 ohm 1% .125W 100PPM 1206 | 4822 051 10829 S |
| R88 | RESISTOR 82 ohm 1% .125W 100PPM 1206 | 4822 051 10829 S |
| R90 | RESISTOR 82 ohm 1% .125W 100PPM 1206 | 4822 051 10829 S |
| R91 | RESISTOR 15.0ohm 1% .125W 100PPM 1206 | 4822 051 10159 S |
| R92 | RESISTOR 82 ohm 1% .125W 100PPM 1206 | 4822 051 10829 S |
| R94 | RESISTOR 15.0ohm 1% .125W 100PPM 1206 | 4822 051 10159 S |
| R95 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R96 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R97 | RESISTOR 47 ohm 1% .125W 100PPM 1206 | 5322 116 80448 S |
| R98 | RESISTOR 1.0 ohm 1% 0.125W 100PPM 1206 | 5322 117 10967 S |
| R99 | RESISTOR 47 ohm 1% .125W 100PPM 1206 | 5322 116 80448 S |
| U1 | TRANSFORMER PM6850-Ser New PS | 5322 148 20036 S |
| U02 | IC PC74HC574T SO20 | 4822 209 60451 S |
| U1 | IC-OP AMP CA3140AM CA3140 AM BIMOS SO8 | 9322 114 39682 S |
| U100 | IC-SRAM IS61C3216-20K SMD 32K*8 SOJ-44 | 9322 165 95701 S |
| U101 | IC-CMOS 74AC08D 4XAND2 SO14 SMD | 5322 209 33102 S |
| U12 | IC-SRAM IS61C3216-20K SMD 32K*8 SOJ-44 | 9322 165 95701 S |
| U14 | IC-CMOS MC74AC573DW 8 LATCH SO20 SMD | 5322 209 90435 S |
| U15 | IC-CMOS MC74AC573DW 8 LATCH SO20 SMD | 5322 209 90435 S |
| U16 | IC SOCKET 32 POL 644 018-3 | 5322 255 40921 S |
| U17 | IC SOCKET 47 POL 644 018-3 | 5322 255 40921 S |
| U18 | IC PC74HC574T SO20 | 4822 209 60451 S |
| U19 | IC PC74HC574T SO20 | 4822 209 60451 S |
| U2 | IC-OP AMP CA3140AM CA3140 AM BIMOS SO8 | 9322 114 39682 S |
| U20 | IC-CMOS MC74AC573DW 8 LATCH SO20 SMD | 5322 209 90435 S |
| U21 | IC-CMOS SMD 74AC11 SO14 31NP AND | 9322 166 59682 S |
| U22 | IC-CMOS SMD 74AC11 SO14 31NP AND | 9322 166 59682 S |
| U23 | IC-CMOS SMD 74AC11 SO14 31NP AND | 9322 166 59682 S |
| U24 | IC-CMOS 74AC20SC SMD SO14 2XNAND4 | 5322 209 90427 S |
| U25 | IC-CMOS 74AC20SC SMD SO14 2XNAND4 | 5322 209 90427 S |
| U26 | IC-CMOS 74AC08D 4XAND2 SO14 SMD | 5322 209 33102 S |
| U27 | IC-CMOS 74AC08D 4XAND2 SO14 SMD | 5322 209 33102 S |
| U28 | IC-CMOS 74AC86D 4XEXOR2 SO14 SMD | 5322 209 33103 S |
| U29 | IC-CMOS SMD 74VHC27 SO14 31NP NOR | 9322 166 60682 S |
| U3 | IC-COMP AD96687BQ DIL16 | 4031 105 03250 S |
| U30 | IC-CMOS SMD 74VHC27 SO14 31NP NOR | 9322 166 60682 S |
| U31 | IC-CMOS 74AC02D 4XNOR2 SO14 SMD | 5322 209 33101 S |
| U32 | IC-CMOS 74AC32D 4XOR2 SO14 SMD | 5322 209 33104 S |
| U33 | IC-CMOS 74AC32D 4XOR2 SO14 SMD | 5322 209 33104 S |
| U34 | IC-CMOS 74AC32D 4XOR2 SO14 SMD | 5322 209 33104 S |
| U35 | IC-CMOS 74AC32D 4XOR2 SO14 SMD | 5322 209 33104 S |
| U36 | IC PC74HC138T SO16 | 5322 209 33178 S |
| U37 | IC-CMOS 74AC74-D 2xD-FF SO-14 SMD | 5322 S |
| U38 | IC-CMOS 74AC74-D 2xD-FF SO-14 SMD | 5322 S |
| U39 | IC-CMOS SMD 74AC191 SO16 UP/DOWN | 9322 165 21701 S |
| U40 | COUNTER IC-CMOS 74AC74-D 2xD-FF SO-14 SMD | 5322 S |
| U41 | IC-CMOS SMD 74AC191 SO16 UP/DOWN | 9322 165 21701 S |
| U44 | COUNTER IC-CMOS MC74AC573DW 8 LATCH SO20 SMD | 5322 209 90435 S |
| U45 | IC-CMOS 74AC02D 4XNOR2 SO14 SMD | 5322 209 33101 S |
| U47 | IC-CMOS 74AC02D 4XNOR2 SO14 SMD | 5322 209 33101 S |
| U48 | IC-CMOS 74AC02D 4XNOR2 SO14 SMD | 5322 209 33101 S |
| U49 | IC-CMOS 74AC02D 4XNOR2 SO14 SMD | 5322 209 33101 S |

| Pos | Description | Part Number ☆ |
|-----|---|------------------|
| U58 | IC SOCKET 68 POL PLCC | 4031 105 71000 |
| U59 | IC-OP AMP OP177GP DIL-8 LOW OFFSET | 9322 170 76682 |
| U6 | IC SOCKET 68 POL PLCC | 5322 255 40677 S |
| U60 | IC PC74HC4353T SO20 | 4822 209 62805 S |
| U61 | IC-OP AMP OP177GP DIL-8 LOW OFFSET | 9322 170 76682 |
| U62 | IC-OP AMP OP177GP DIL-8 LOW OFFSET | 9322 170 76682 |
| U63 | IC-DAC 12BIT AD7545AKN DIL20 | 5322 209 62107 S |
| U64 | IC-DAC 12BIT AD7545AKN DIL20 | 5322 209 62107 S |
| U65 | IC-OP AMP OP177GP DIL-8 LOW OFFSET | 9322 170 76682 |
| U66 | IC-OP AMP OP177GP DIL-8 LOW OFFSET | 9322 170 76682 |
| U67 | IC NE532D DUAL SO-8 | 5322 209 71553 S |
| U69 | HEAT SINK 160K/W LODBAR TO219 | 5322 255 41313 P |
| U69 | IC 12 V UA7812UC 1A TO-220 | 5322 209 86176 S |
| U7 | IC 1.50 A LM317T TO-220 | 4822 209 80591 S |
| U70 | IC 1.50 A LM317T TO-220 | 4822 209 80591 S |
| U71 | IC-REG TL431C-LP TO92 | 4822 209 81397 S |
| U72 | IC-OP AMP OP177GP DIL-8 LOW OFFSET | 9322 170 76682 |
| U73 | HEAT SINK 160K/W LODBAR TO220 | 5322 255 41313 P |
| U73 | IC 1.50 A LM337T TO-220 | 5322 209 81236 S |
| U74 | IC-REG TL431C-LP TO92 | 4822 209 81397 S |
| U75 | IC-OP AMP CA3140AM CA3140 AM BIMOS SO8 | 9322 114 39682 |
| U76 | IC-CMOS 74AC74-D 2xD-FF SO-14 SMD | 5322 S |
| U77 | IC NE532D DUAL SO-8 | 5322 209 71553 S |
| U78 | IC-DIG UPD7210D IEC BUS GPIB CONTROLLER | 9322 023 60682 |
| U79 | IC SN75161AN | 5322 209 81842 S |
| U8 | IC TL7770-50W | 5322 209 30397 S |
| U80 | IC SN75160AN | 5322 209 81807 S |
| U81 | IC-CMOS 74AC74-D 2xD-FF SO-14 SMD | 5322 S |
| U82 | IC-CMOS SMD 74AC11 SO14 31NP AND | 9322 166 59682 S |
| U84 | IC-DIG ECL 100304PC 5XAND/NAND2 PDIP24 | 5322 209 33638 S |
| U85 | IC SOCKET 28 POL 821581-1 PLCC | 2422 486 80183 S |
| U85 | IC-DIG ECL 100331QC 3XDFLIP-FLOP PCC28 | 5322 209 33604 S |
| U86 | IC-REF 2.50 V MC1403U DIL-8 | 5322 209 82864 S |
| U87 | IC-CMOS 74AC20SC SMD SO14 2XNAND4 | 5322 209 90427 S |
| U88 | IC-BUS TRANSCEIV 75ALS176D SO-8 SMD | 5322 209 33171 S |
| U9 | IC-SRAM CY62256LL-70SNC SMD 32K*8 SO28 | 9322 130 52701 S |
| U90 | OPTOCOUPLER CNX82A SEMKO SOT231 | 4822 130 10025 S |
| U91 | IC-ANA SMPS CTR UC3842AD SO14 | 5322 209 33169 S |
| U92 | IC-REF 2.5V TL4311-D SO8 | 5322 209 62422 S |
| U93 | IC-CMOS 74AC02D 4XNOR2 SO14 SMD | 5322 209 33101 S |
| U94 | IC-CMOS SMD 74AC86SC SO14 21NP EXOR | 9322 167 94682 S |
| U95 | IC NE532D DUAL SO-8 | 5322 209 71553 S |
| U97 | IC 14C88M SO14 | 5322 209 33108 S |
| U98 | IC-CMOS 74AC08D 4XAND2 SO14 SMD | 5322 209 33102 S |
| U99 | IC NE532D DUAL SO-8 | 5322 209 71553 S |
| V1 | TRANSISTOR BF513 .03A20V SOT23 | 4822 130 60686 S |
| V12 | TRANSISTOR BSR12 0.1A 15V SOT23 | 5322 130 44743 S |
| V14 | TRANSISTOR BSR12 0.1A 15V SOT23 | 5322 130 44743 S |
| V15 | TRANSISTOR BC847B .1A45V SOT23 | 4822 130 60511 S |
| V16 | TRANSISTOR BC857B .1A45V SOT23 | 5322 130 60508 S |
| V17 | TRANSISTOR BC857B .1A45V SOT23 | 5322 130 60508 S |
| V18 | TRANSISTOR BC369 1A 20V TO92 | 5322 130 44593 S |
| V19 | TRANSISTOR BFS17 .05A 15V SOT23 | 5322 130 40781 S |
| V2 | TRANSISTOR BF513 .03A20V SOT23 | 4822 130 60686 S |
| V20 | TRANSISTOR 25 MA BFR92A 20V SOT23 | 5322 130 60647 S |
| V21 | TRANSISTOR BF513 .03A20V SOT23 | 4822 130 60686 S |
| V22 | TRANSISTOR 25 MA BFR92A 20V SOT23 | 5322 130 60647 S |
| V23 | TRANSISTOR BFG97 0.1A 15V SO223 | 4822 130 63069 S |
| V25 | TRANSISTOR 25 MA BFR92A 20V SOT23 | 5322 130 60647 S |
| V26 | TRANSISTOR BFG97 0.1A 15V SO223 | 4822 130 63069 S |
| V27 | TRANSISTOR BFS17 .05A 15V SOT23 | 5322 130 40781 S |
| V28 | TRANSISTOR 25 MA BFR92A 20V SOT23 | 5322 130 60647 S |
| V29 | TRANSISTOR BFG97 0.1A 15V SO223 | 4822 130 63069 S |
| V3 | TRANSISTOR BFS17 .05A 15V SOT23 | 5322 130 40781 S |
| V31 | TRANSISTOR 25 MA BFR92A 20V SOT23 | 5322 130 60647 S |
| V32 | TRANSISTOR BFG97 0.1A 15V SO223 | 4822 130 63069 S |
| V33 | TRANSISTOR BFS17 .05A 15V SOT23 | 5322 130 40781 S |
| V4 | TRANSISTOR BFS17 .05A 15V SOT23 | 5322 130 40781 S |
| V40 | TRANSISTOR BFS17 .05A 15V SOT23 | 5322 130 40781 S |
| V41 | TRANSISTOR BFS17 .05A 15V SOT23 | 5322 130 40781 S |
| V42 | TRANSISTOR BFS17 .05A 15V SOT23 | 5322 130 40781 S |
| V43 | TRANSISTOR BSV52 0.1A 12V SOT23 | 5322 130 44336 S |
| V44 | TRANSISTOR BC847B .1A45V SOT23 | 4822 130 60511 S |
| V45 | TRANSISTOR BC847B .1A45V SOT23 | 4822 130 60511 S |
| V46 | TRANSISTOR BC847B .1A45V SOT23 | 4822 130 60511 S |
| V47 | TRANSISTOR BC847B .1A45V SOT23 | 4822 130 60511 S |
| V48 | TRANSISTOR BC847B .1A45V SOT23 | 4822 130 60511 S |
| V49 | TRANSISTOR BC847B .1A45V SOT23 | 4822 130 60511 S |
| V50 | TRANSISTOR BC847B .1A45V SOT23 | 4822 130 60511 S |
| V51 | TRANSISTOR BC847B .1A45V SOT23 | 4822 130 60511 S |
| V52 | TRANSISTOR BC847B .1A45V SOT23 | 4822 130 60511 S |
| V53 | TRANSISTOR BC847B .1A45V SOT23 | 4822 130 60511 S |
| V54 | TRANSISTOR BC847B .1A45V SOT23 | 4822 130 60511 S |
| V55 | HEAT SINK 13.50K/W KS35.10-25EL 2x2.3 | 5322 255 41314 P |
| V55 | TRANSI-POW MOS 4A STP4NC80ZFP TO220FP | 9322 164 04701 S |
| V56 | TRANSISTOR 0.5A BC807-25 45V SOT23 | 5322 130 60845 S |
| V57 | TRANSISTOR 0.5A BC817-25 45V SOT23 | 4822 130 42804 S |
| V58 | TRANSISTOR 0.5A BC817-25 45V SOT23 | 4822 130 42804 S |
| V59 | TRANSISTOR 0.5A BC817-25 45V SOT23 | 4822 130 42804 S |
| V60 | TRANSISTOR 0.5A BC817-25 45V SOT23 | 4822 130 42804 S |
| V61 | TRANSISTOR BC847B .1A45V SOT23 | 4822 130 60511 S |
| V62 | TRANSISTOR BCP51 1.5A 45V SOT223 | 5322 130 62639 S |
| V63 | TRANSISTOR 0.5A BC817-25 45V SOT23 | 4822 130 42804 S |
| V64 | TRANSISTOR 0.5A BC807-25 45V SOT23 | 5322 130 60845 S |
| V65 | TRANSISTOR BC847B .1A45V SOT23 | 4822 130 60511 S |
| V66 | TRANSISTOR BC857B .1A45V SOT23 | 5322 130 60508 S |
| V67 | TRANSISTOR BFS17 .05A 15V SOT23 | 5322 130 40781 S |
| V68 | TRANSISTOR BFS17 .05A 15V SOT23 | 5322 130 40781 S |
| V69 | TRANSISTOR BC847B .1A45V SOT23 | 4822 130 60511 S |
| V70 | TRANSISTOR BC847B .1A45V SOT23 | 4822 130 60511 S |
| V8 | TRANSISTOR BFS17 .05A 15V SOT23 | 5322 130 40781 S |
| V9 | TRANSISTOR BSR12 0.1A 15V SOT23 | 5322 130 44743 S |

| Pos | Description | Part Number ☆ |
|-----|---------------------------------|------------------|
| X2 | CONNECTOR 3 POL F095 SINGLE ROW | 5322 290 60445 S |
| X4 | CONNECTOR 3 POL F095 SINGLE ROW | 5322 290 60445 S |

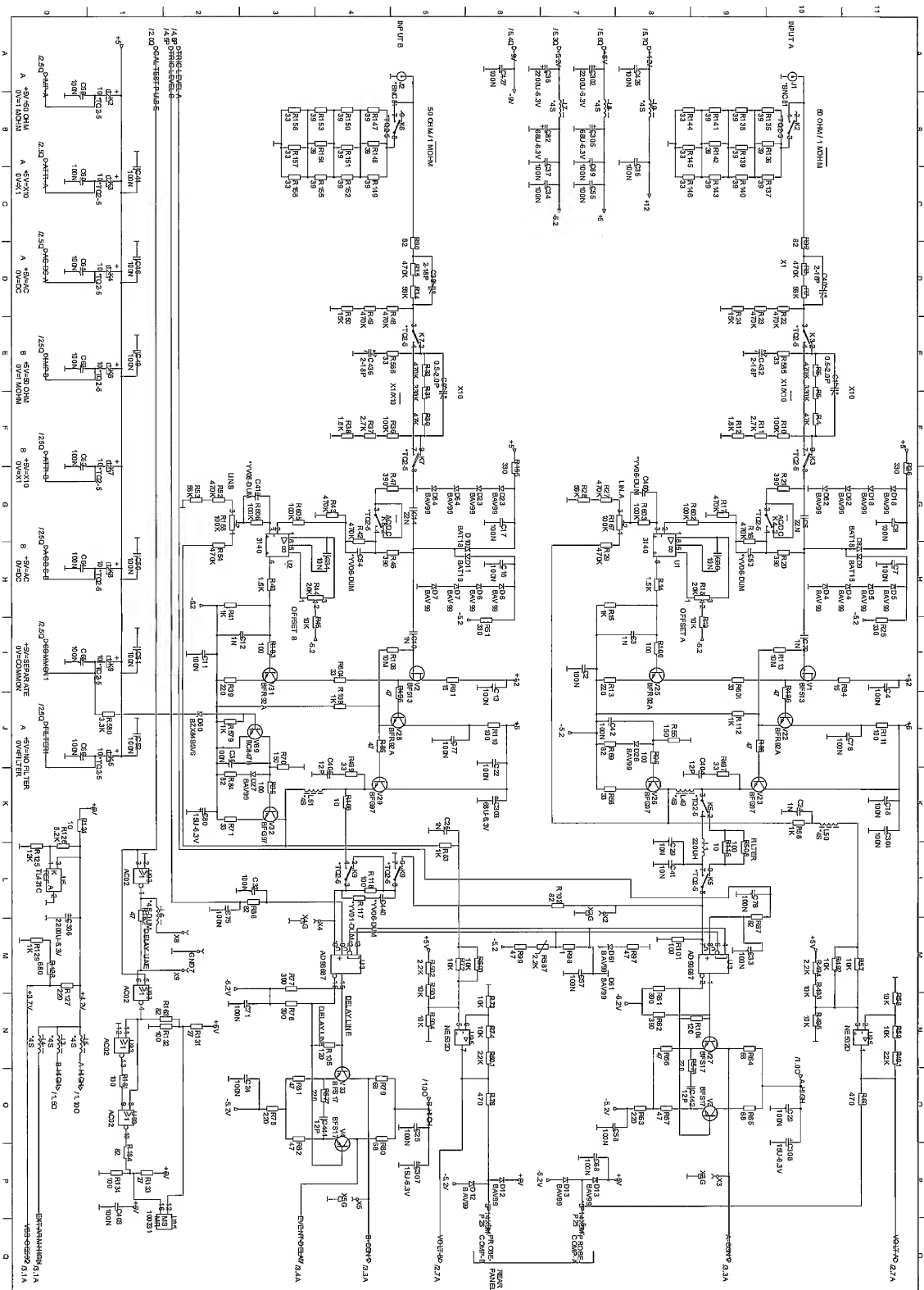
Schematic Diagrams

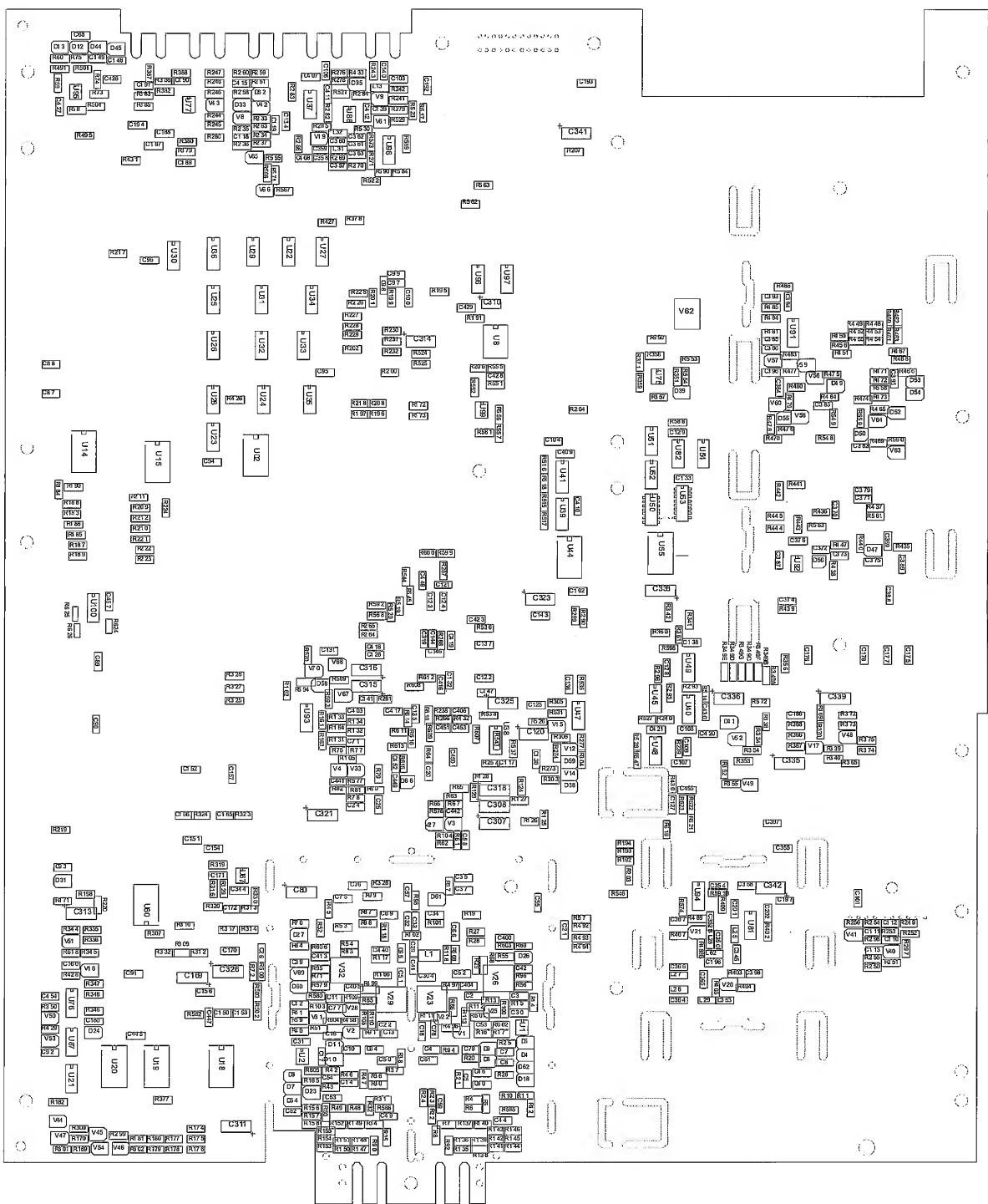
Main Board, Component Layout



Top Side

Input Amplifier, Unit 1 sheet 1(6)

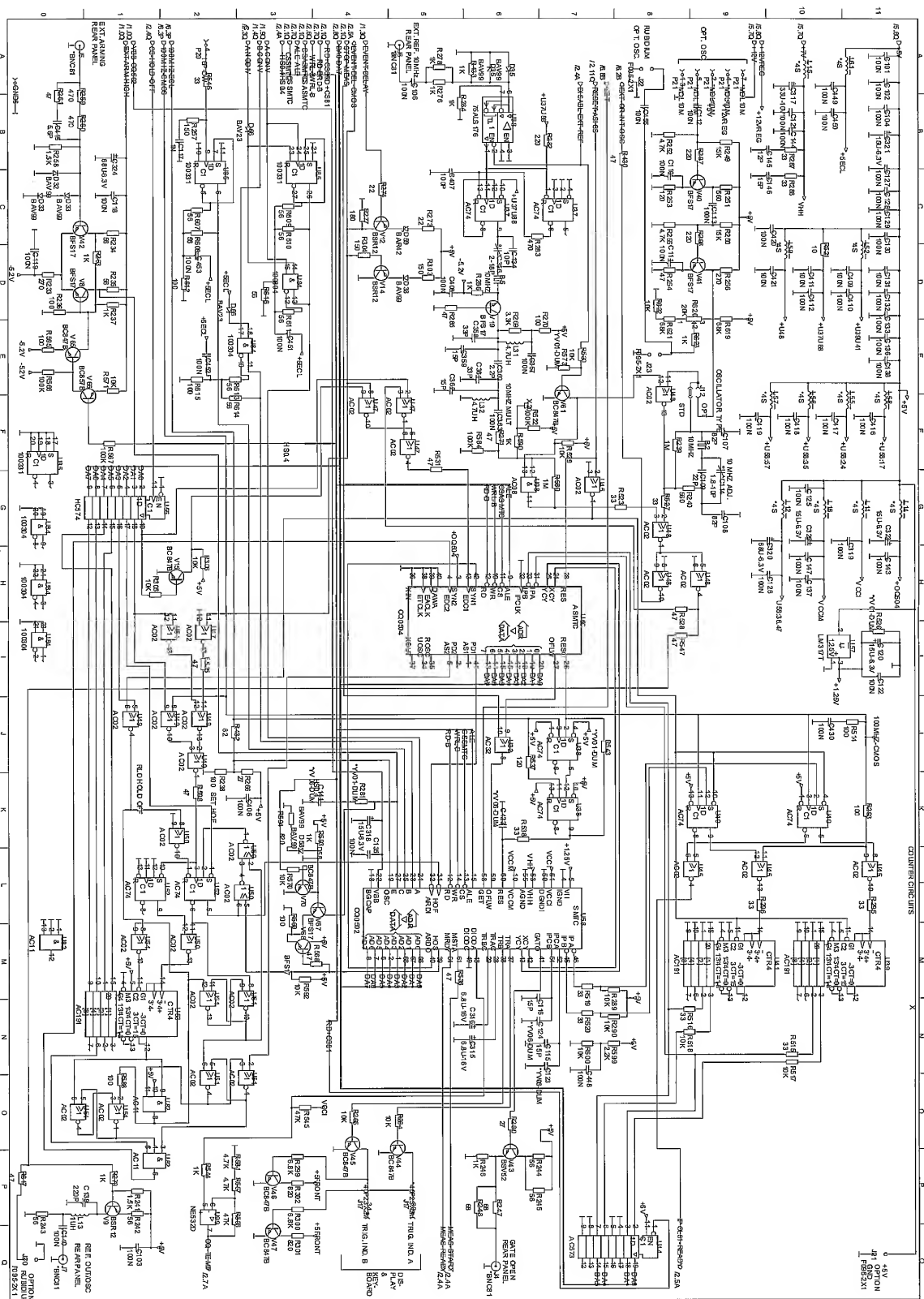




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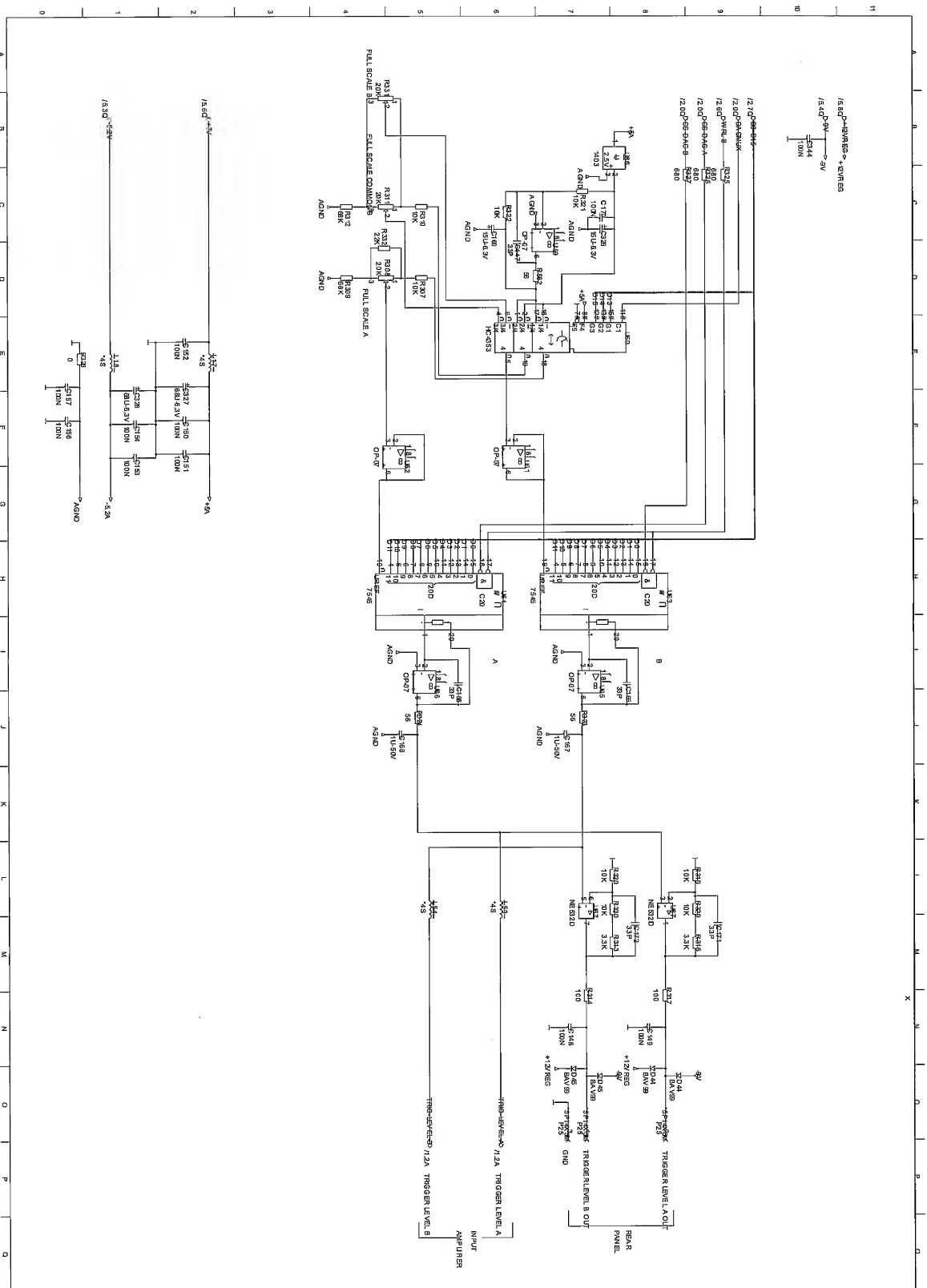
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Counter Circuits, Unit 1 sheet 3(6)

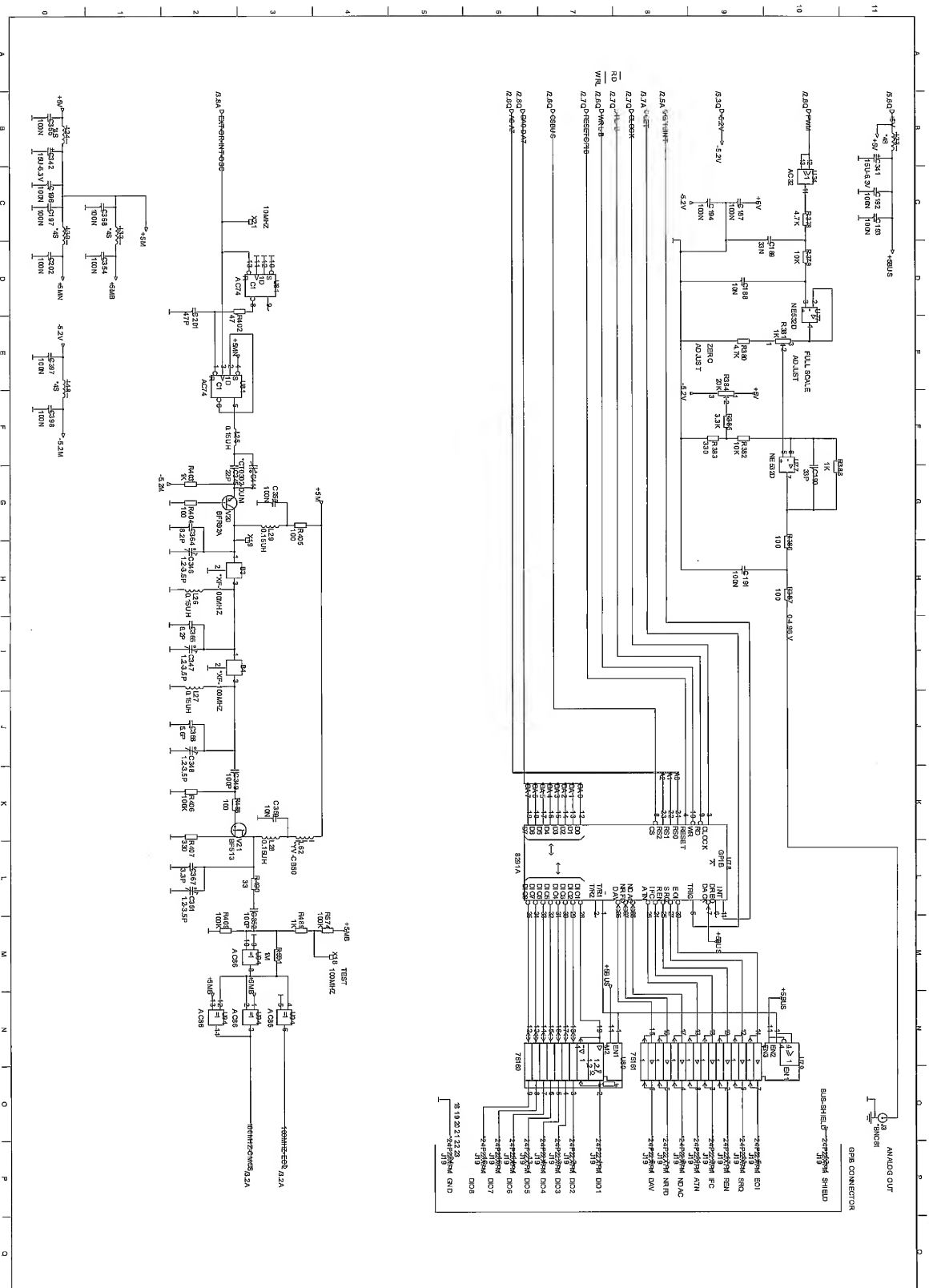


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Trigger Level DACs, Unit 1 sheet 4(6)



GPIB Interface & Analog Output, Unit 1 sheet 6(6)



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Model PM6681R

Rubidium Timebase

Introduction

A rubidium timebase (atomic clock reference) is now available in the Model PM6681R Timer/Counter/Analyzer. This oscillator cannot be retrofitted. Due to the power requirements, an additional built-in power supply is needed. It is located on the same board as the distribution amplifiers for the six extra reference outputs included in this instrument.

Performance Check

The general rules in Chapter 2 apply, but observe the additional instructions below.

NOTE: To fully test the accuracy of the PM6681R, access to an extremely high stability reference signal is needed, for example a Cesium Atomic Reference or a transmitted signal from a nationally or internationally traceable source. Additionally the instrument has to be stabilized for a period of one month.

The PM6681R has an UNLOCKED/STANDBY LED. When the LED is lit the Rubidium time base is still in its warm-up phase and is not yet stabilized.

■ Test procedure

- Connect the counter to the line power.
- Check that the UNLOCKED/STANDBY LED is lit.
- Turn on the Timer/Counter
- Check that the UNLOCKED/STANDBY LED is switched off within 5 minutes after connection to line power.
- Connect a 10 MHz reference signal to input A of the counter.
- Select FREQUENCY A measurement.
- Select 1 s measuring time.
- Check that the displayed frequency is $10.00000000 \text{ MHz} \pm 1 \text{ LSD} < 6 \text{ minutes}$ after connection to line power.

NOTE: The rubidium timebase unit must be sent to a Fluke service center for repair. Follow the exchange procedure.

Calibration and Adjustment

NOTE: Before adjusting the oscillator, the timer/counter must have been continuously connected to the ac power line for at least 24 hours.

Required test equipment

| Type | Uncertainty | Model |
|------------------|-----------------------|------------------|
| 10 MHz reference | $< 2 \times 10^{-11}$ | Cesium / GPS |
| Timer/Counter | | PM6681 |
| GPIB controller | | PC+GPIB+TimeView |

■ Setup

- Connect the 10 MHz reference to the REFERENCE IN connector on the rear panel of the timer/counter and make sure that External Reference is selected on the front panel.
- Connect one of the 10 MHz outputs on the rear panel of the PM6681R – the Device Under Test (DUT) – to Input A of the timer/counter.

■ Calibration measurement

- Set the measurement time of the timer/counter to 10 s.
- Select MATH ($K \cdot X + L$) and set a negative offset of 10 MHz ($L = -10E6$).
- Select STAT (statistics), $N=100$, and MEAN.
- Press RESTART. After approx. 17 minutes the mean value over 100 readings is displayed.

NOTE: If a GPS receiver is used as a reference, change number of samples N in the STAT menu to 8640 (instead of 100) to enable a frequency mean value over 24 h (instead of 17 min). GPS receivers have an excellent long-term stability (24 h) but can be quite unstable over shorter periods.

■ Adjustment criteria

If the display reading does not exceed 0.5 mHz ($0.5 \times 10^{-3} \text{ Hz}$), no adjustment is required.

■ Adjustment procedure

- Switch off statistics (STAT OFF) in the timer/counter.
- Remove the seal sticker from the front panel of the DUT (below 'Ref Adj' to the left of the PRESET button).
- Adjust the potentiometer behind the seal until the display of the timer/counter shows $0.5 \times 10^{-3} \text{ Hz}$ or less.
- Repeat the calibration measurement described above to verify the adjustment.

- Check that the value is stable over time (>30 min). TimeView is an excellent tool for viewing frequency stability over time.
- Attach a new calibration seal sticker so that it covers the hole in the front panel.

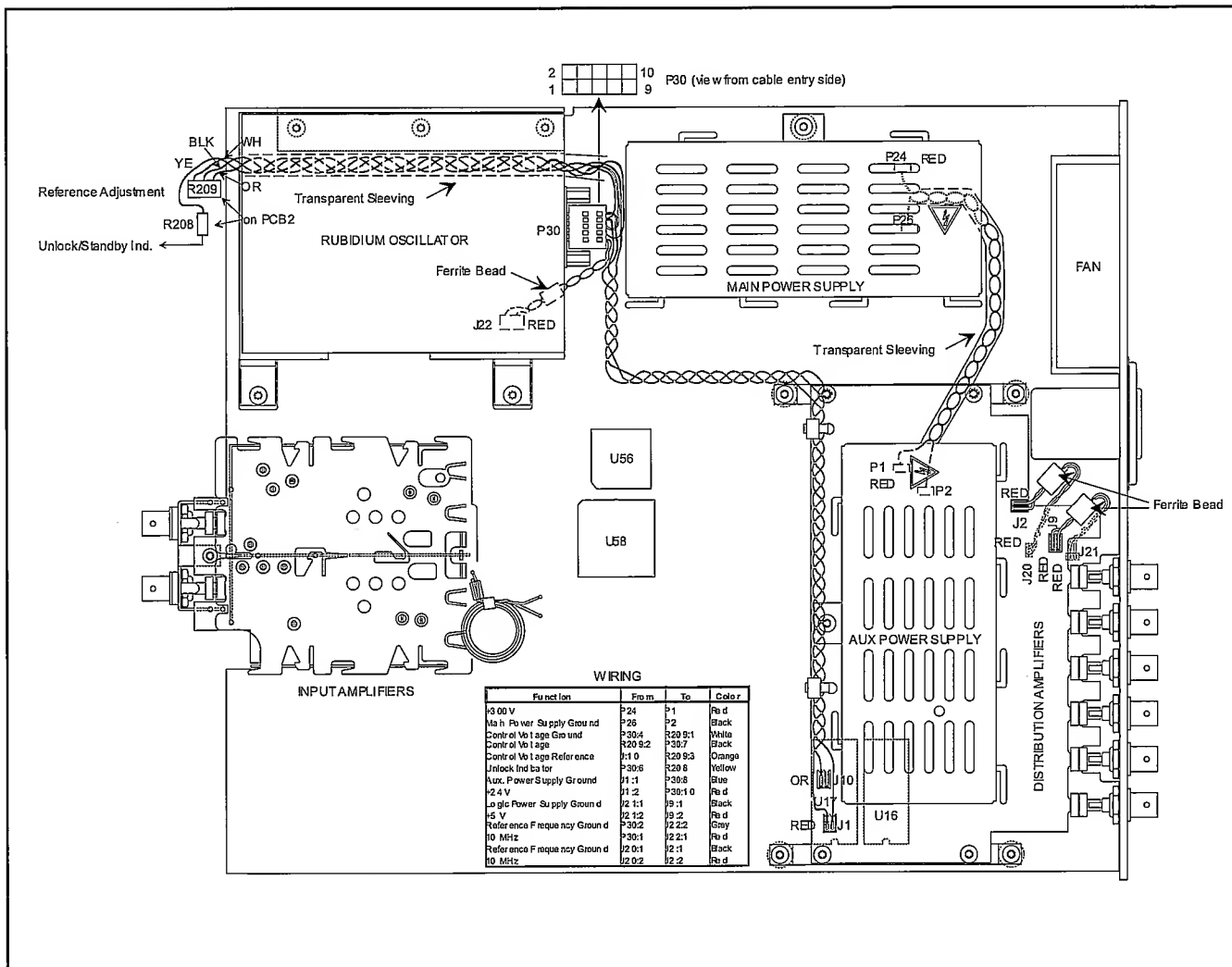


Fig. 9-8 Location of the Rubidium timebase and its power supply & distribution amplifiers including the wiring between these units.

OCXO Range Extended

New OCXOs

Oven-Controlled Oscillators, PM9691 & PM9692

The PM9691 is adjusted to 10 MHz \pm 0.2 Hz when manufactured, the PM9692 to 10 MHz \pm 0.05 Hz, so there is no need to adjust the frequency directly after installation.

These oscillators, like any oscillator, change frequency because of aging. Use the table in the Operators Manual, Chapter 10, to calculate when calibration is due. The complete specifications can be found in the same manual, Chapter 11.

Required test equipment

| Instrument | Required specification | Model |
|---------------------------------|---|-----------------|
| Counter with Rubidium Reference | 10 MHz \pm 0.01 Hz (Uncertainty $\leq 1 \times 10^{-9}$) | PM6681R/PM6685R |

Table 9-1

■ Setup

- Connect the counter to the line power.
- Switch on the counter.
- Set the counter to default settings (preset).

Make the adjustment at an ambient temperature of +23 °C, if possible. The oscillator must have been operating continuously for 48 hours before an adjustment.

- Connect the 10 MHz OUT socket of the counter to be adjusted (rear panel) to the Input A of the PM6681R/PM6685R.
- Set up the PM6681R/PM6685R:
 - Measuring time = 0.5 s
 - 50 Ω input impedance
 - Frequency A measurements

■ Adjustment

The oscillator has a voltage controlled adjustment range. This range is divided into five fixed steps set via DIP switches, and a trimmer to fine-tune the control voltage.

Normally the range of the trimmer should be sufficient to compensate for the aging that occurs during at least two years of operation.

Fine adjustment

- Adjust the trimmer to better than 10 MHz \pm 0.2 Hz (PM9691) or 10 MHz \pm 0.05 Hz (PM9692), i.e. \pm 20 resp. \pm 5 in the last two digits on the PM6681R/PM6685R display.

- If this adjustment is OK, reassemble the counter.

Coarse adjustment

Make this adjustment only if the trimmer range is insufficient to adjust the oscillator.

- Remove the tape from the DIP-switch.
- Adjust the trimmer to its mid position (about 12 turns from either end position).
- Read the frequency on the PM6681R/PM6685R. (Nominal 10.000000 MHz)
 - If the frequency is too low, set the DIP-switches to the next higher voltage range.
 - If the frequency is too high, set the DIP-switches to the next lower voltage range.

| Trimmer range (V) | DIP switch number (1 = on, 0 = off) | | | | | | | |
|-------------------|-------------------------------------|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 2.6 - 3.4 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 3.2 - 3.9 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 |
| 3.5 - 4.3 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| 4.0 - 4.7 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| 4.1 - 5.0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 |

Table 9-2 Coarse adjustment by means of DIP switches.

- Check that the new trimmer range is about \pm 2 Hz around 10 MHz.

Adjust the trimmer according to 'Fine adjustment' above.

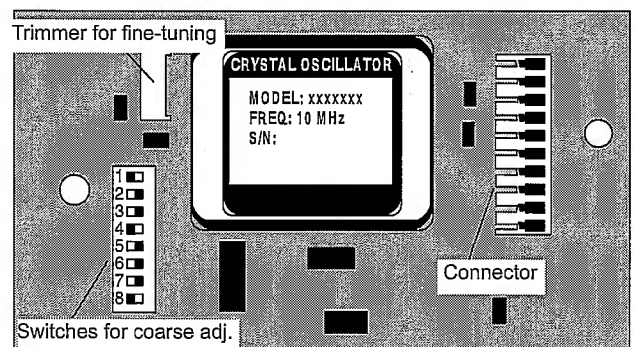


Fig. 9-9 Adjusting the optional oscillator frequency.

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Option PM9671B

Introduction

This optional reference output unit replaces the extra 5x10 MHz + 1x5 MHz outputs of the PM6681R and offers more frequencies (1x0.1 MHz, 1x1 MHz, 1x5 MHz and 3x10 MHz with higher output level (1 V_{RMS} versus 0.6 V_{RMS}). The standard 10 MHz, 0.6 V_{RMS} output of PM6681R is not affected.

Performance Check

Connect an oscilloscope to the outputs marked I, J, K, L, M and N and check the frequencies (0.1, 1, 5, 10, 10 and 10 MHz), the waveform (sinusoidal) and the level (>1 V_{RMS}).

Adjustments

No adjustments can be made. The output frequencies are locked to the internal/external timebase, depending on the source selected via the front panel or by means of a GPIB command. The default timebase source is the built-in reference oscillator.

Replacement Parts (PM9671B)

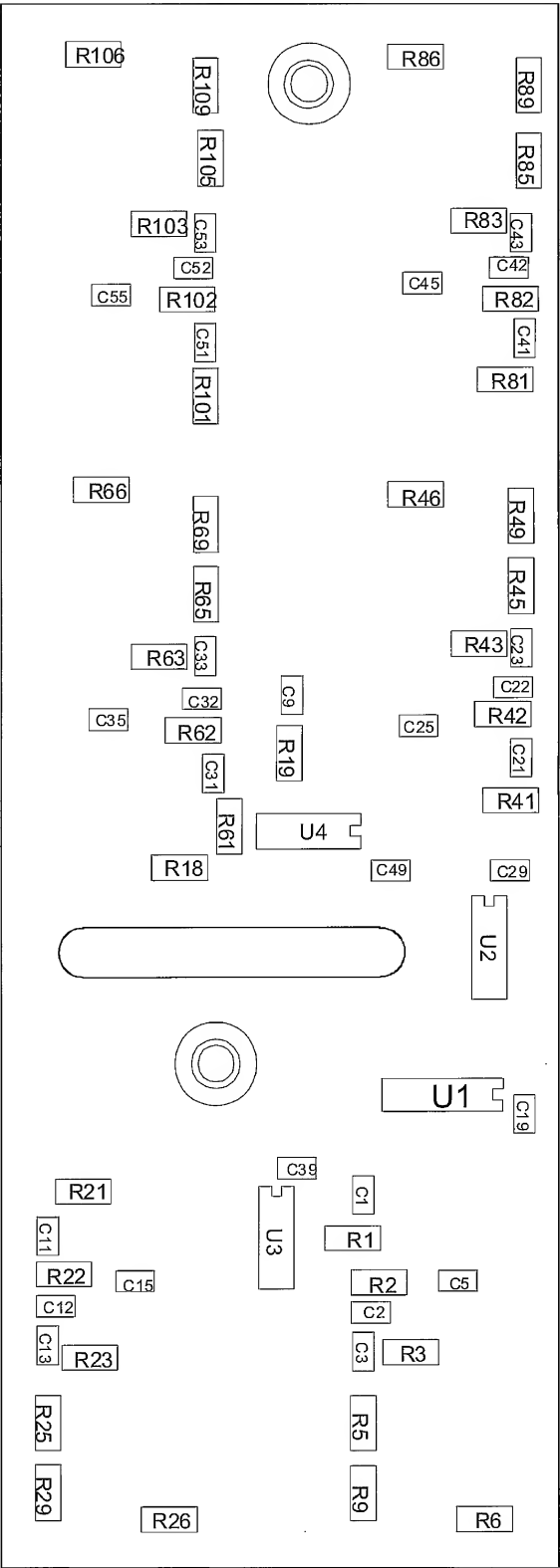
| Pos | Description | Part Number ☆ | Pos | Description | Part Number ☆ |
|-----|--|------------------|-----|--|------------------|
| 15 | LABEL STATUS 25.4X12.7 POLYIMIDE | 5322 454 13144 P | C49 | CAPACITOR 100nF 20% 25V X7R 0805 | 5322 126 13638 S |
| 27 | CONNECTOR 2 POL 640442-2 AWG26 IDT | 5322 265 41371 S | C5 | CAPACITOR 100nF 20% 25V X7R 0805 | 5322 126 13638 S |
| C1 | CAPACITOR 8.2nF 50V X7R C0805C822K5RAC | 2022 552 05597 | C51 | CAPACITOR 33pF 5% 50V NP0 0805 | 2222 861 15339 |
| C11 | CAPACITOR 220pF 5% 50V NP0 0805 | 4822 122 33575 S | C52 | CAPACITOR 82pF 5% 50V NP0 0805 | 2222 861 15829 |
| C12 | CAPACITOR 820pF 5% 50V NP0 0805 | 2238 861 15821 | C53 | CAPACITOR 1nF 20% 50V X7R 0805 | 5322 122 34123 S |
| C13 | CAPACITOR 10nF 20% 50V X7R 0805 | 5322 122 34098 S | C54 | CAPACITOR 100nF 20% 25V X7R 0805 | 5322 126 13638 S |
| C14 | CAPACITOR 100nF 20% 25V X7R 0805 | 5322 126 13638 S | C55 | CAPACITOR 100nF 20% 25V X7R 0805 | 5322 126 13638 S |
| C15 | CAPACITOR 100nF 20% 25V X7R 0805 | 5322 126 13638 S | C56 | CAPACITOR 6.80 µF 20% 16V 6.0X3.2 MOLD | 5322 124 10687 R |
| C16 | CAPACITOR 6.80 µF 20% 16V 6.0X3.2 MOLD | 5322 124 10687 R | C57 | CAPACITOR 100nF 20% 25V X7R 0805 | 5322 126 13638 S |
| C17 | CAPACITOR 100nF 20% 25V X7R 0805 | 5322 126 13638 S | C6 | CAPACITOR 6.80 µF 20% 16V 6.0X3.2 MOLD | 5322 124 10687 R |
| C19 | CAPACITOR 100nF 20% 25V X7R 0805 | 5322 126 13638 S | C7 | CAPACITOR 220nF 10% 63V X7R 1206 | 5322 126 13642 S |
| C2 | CAPACITOR 8.2nF 50V X7R C0805C822K5RAC | 2022 552 05597 | C8 | CAPACITOR 15 µF 20% 6.3V 6.0X3.2 MOLD | 5322 124 11418 S |
| C21 | CAPACITOR 47pF 5% 50V NP0 0805 | 2222 861 15479 | C9 | CAPACITOR 47pF 5% 50V NP0 0805 | 2222 861 15479 |
| C22 | CAPACITOR 150pF 5% 50V NP0 0805 | 2222 861 15151 | D1 | DIODE 0.10A BAV99 SOT23 | 5322 130 34337 S |
| C23 | CAPACITOR 1nF 20% 50V X7R 0805 | 5322 122 34123 S | D10 | DIODE 0.10A BAV99 SOT23 | 5322 130 34337 S |
| C24 | CAPACITOR 100nF 20% 25V X7R 0805 | 5322 126 13638 S | D11 | DIODE BYD17G 400V 1.5A SOD87 | 9338 122 40701 |
| C25 | CAPACITOR 100nF 20% 25V X7R 0805 | 5322 126 13638 S | D12 | DIODE BYD17G 400V 1.5A SOD87 | 9338 122 40701 |
| C26 | CAPACITOR 6.80 µF 20% 16V 6.0X3.2 MOLD | 5322 124 10687 R | D13 | DIODE 0.10A BAV99 SOT23 | 5322 130 34337 S |
| C27 | CAPACITOR 100nF 20% 25V X7R 0805 | 5322 126 13638 S | D14 | DIODE BYD17G 400V 1.5A SOD87 | 9338 122 40701 |
| C29 | CAPACITOR 100nF 20% 25V X7R 0805 | 5322 126 13638 S | D15 | DIODE BYD17G 400V 1.5A SOD87 | 9338 122 40701 |
| C3 | CAPACITOR 100nF 20% 25V X7R 0805 | 5322 126 13638 S | D16 | DIODE 0.10A BAV99 SOT23 | 5322 130 34337 S |
| C31 | CAPACITOR 33pF 5% 50V NP0 0805 | 2222 861 15339 | D17 | DIODE BYD17G 400V 1.5A SOD87 | 9338 122 40701 |
| C32 | CAPACITOR 82pF 5% 50V NP0 0805 | 2222 861 15829 | D18 | DIODE BYD17G 400V 1.5A SOD87 | 9338 122 40701 |
| C33 | CAPACITOR 1nF 20% 50V X7R 0805 | 5322 122 34123 S | D2 | DIODE BYD17G 400V 1.5A SOD87 | 9338 122 40701 |
| C34 | CAPACITOR 100nF 20% 25V X7R 0805 | 5322 126 13638 S | D3 | DIODE BYD17G 400V 1.5A SOD87 | 9338 122 40701 |
| C35 | CAPACITOR 100nF 20% 25V X7R 0805 | 5322 126 13638 S | D4 | DIODE 0.10A BAV99 SOT23 | 5322 130 34337 S |
| C36 | CAPACITOR 6.80 µF 20% 16V 6.0X3.2 MOLD | 5322 124 10687 R | D5 | DIODE BYD17G 400V 1.5A SOD87 | 9338 122 40701 |
| C37 | CAPACITOR 100nF 20% 25V X7R 0805 | 5322 126 13638 S | D6 | DIODE BYD17G 400V 1.5A SOD87 | 9338 122 40701 |
| C39 | CAPACITOR 100nF 20% 25V X7R 0805 | 5322 126 13638 S | D7 | DIODE 0.10A BAV99 SOT23 | 5322 130 34337 S |
| C4 | CAPACITOR 100nF 20% 25V X7R 0805 | 5322 126 13638 S | D8 | DIODE BYD17G 400V 1.5A SOD87 | 9338 122 40701 |
| C41 | CAPACITOR 33pF 5% 50V NP0 0805 | 2222 861 15339 | D9 | DIODE BYD17G 400V 1.5A SOD87 | 9338 122 40701 |
| C42 | CAPACITOR 82pF 5% 50V NP0 0805 | 2222 861 15829 | J2 | CONNECTOR 10 POL 22-14-2104 4455-BC | 5322 267 50336 S |
| C43 | CAPACITOR 1nF 20% 50V X7R 0805 | 5322 122 34123 S | J3 | CONTACT PIN MINICOAX FOR PC-B | 5322 268 14141 S |
| C44 | CAPACITOR 100nF 20% 25V X7R 0805 | 5322 126 13638 S | J3 | BUSHING MINICOAX FOR PC-B | 5322 268 24116 S |
| C45 | CAPACITOR 100nF 20% 25V X7R 0805 | 5322 126 13638 S | J4 | CONTACT PIN MINICOAX FOR PC-B | 5322 268 14141 S |
| C46 | CAPACITOR 6.80 µF 20% 16V 6.0X3.2 MOLD | 5322 124 10687 R | J4 | BUSHING MINICOAX FOR PC-B | 5322 268 24116 S |
| C47 | CAPACITOR 100nF 20% 25V X7R 0805 | 5322 126 13638 S | J5 | CONTACT PIN MINICOAX FOR PC-B | 5322 268 14141 S |

| Pos | Description | Part Number ☆ |
|------|--|------------------|
| J5 | BUSHING MINICOAX FOR PC-B | 5322 268 24116 S |
| J6 | CONTACT PIN MINICOAX FOR PC-B | 5322 268 14141 S |
| J6 | BUSHING MINICOAX FOR PC-B | 5322 268 24116 S |
| J7 | CONTACT PIN MINICOAX FOR PC-B | 5322 268 14141 S |
| J7 | BUSHING MINICOAX FOR PC-B | 5322 268 24116 S |
| J8 | CONTACT PIN MINICOAX FOR PC-B | 5322 268 14141 S |
| J8 | BUSHING MINICOAX FOR PC-B | 5322 268 24116 S |
| L1 | CHOKE 470µH 10% BCL453232-471K | 2422 536 00389 |
| L10 | FILTER-EMI BLM21A102SPT Z=1Kohm 0.2A R=0.6ohm | 2422 549 43133 |
| L11 | CHOKE 4.70µH 5% LQH1N4R7J | 2422 535 94048 |
| L12 | FILTER-EMI BLM21A102SPT Z=1Kohm 0.2A R=0.6ohm | 2422 549 43133 |
| L2 | FILTER-EMI BLM21A102SPT Z=1Kohm 0.2A R=0.6ohm | 2422 549 43133 |
| L3 | CHOKE 47µH 10% BCL322522-470K | 2422 536 00388 |
| L4 | FILTER-EMI BLM21A102SPT Z=1Kohm 0.2A R=0.6ohm | 2422 549 43133 |
| L5 | CHOKE 10µH 10% BCL322522-100K | 2422 536 00387 |
| L6 | FILTER-EMI BLM21A102SPT Z=1Kohm 0.2A R=0.6ohm | 2422 549 43133 |
| L7 | CHOKE 4.70µH 5% LQH1N4R7J | 2422 535 94048 |
| L8 | FILTER-EMI BLM21A102SPT Z=1Kohm 0.2A R=0.6ohm | 2422 549 43133 |
| L9 | CHOKE 4.70µH 5% LQH1N4R7J | 2422 535 94048 |
| Q1 | TRANSI-NPN SMD BFG16A SOT223 1.5GHz 1W | 9340 022 10701 |
| Q10 | TRANSI-NPN SMD BFG16A SOT223 1.5GHz 1W | 9340 022 10701 |
| Q11 | TRANSI-NPN SMD BFG16A SOT223 1.5GHz 1W | 9340 022 10701 |
| Q12 | TRANSI-NPN SMD BFG16A SOT223 1.5GHz 1W | 9340 022 10701 |
| Q2 | TRANSI-NPN SMD BFG16A SOT223 1.5GHz 1W | 9340 022 10701 |
| Q3 | TRANSI-NPN SMD BFG16A SOT223 1.5GHz 1W | 9340 022 10701 |
| Q4 | TRANSI-NPN SMD BFG16A SOT223 1.5GHz 1W | 9340 022 10701 |
| Q5 | TRANSI-NPN SMD BFG16A SOT223 1.5GHz 1W | 9340 022 10701 |
| Q6 | TRANSI-NPN SMD BFG16A SOT223 1.5GHz 1W | 9340 022 10701 |
| Q7 | TRANSI-NPN SMD BFG16A SOT223 1.5GHz 1W | 9340 022 10701 |
| Q8 | TRANSI-NPN SMD BFG16A SOT223 1.5GHz 1W | 9340 022 10701 |
| Q9 | TRANSI-NPN SMD BFG16A SOT223 1.5GHz 1W | 9340 022 10701 |
| R1 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R10 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R101 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R103 | RESISTOR 3.30kohm 1% .125W 100PPM 1206 | 4822 051 53302 S |
| R104 | RESISTOR 47 ohm 1% 0.1W 100PPM 0805 | 5322 117 12505 S |
| R105 | RESISTOR 5.60kohm 1% .125W 100PPM 1206 | 4822 051 10562 S |
| R106 | RESISTOR 1.50kohm 1% 0.125W 100PPM 1206 | 4822 051 51502 S |
| R107 | RESISTOR 47 ohm 1% 0.1W 100PPM 0805 | 5322 117 12505 S |
| R108 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R109 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R11 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R110 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R111 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R19 | RESISTOR 120 ohm 1% 0.125W 100PPM 1206 | 4822 051 10121 S |
| R21 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |

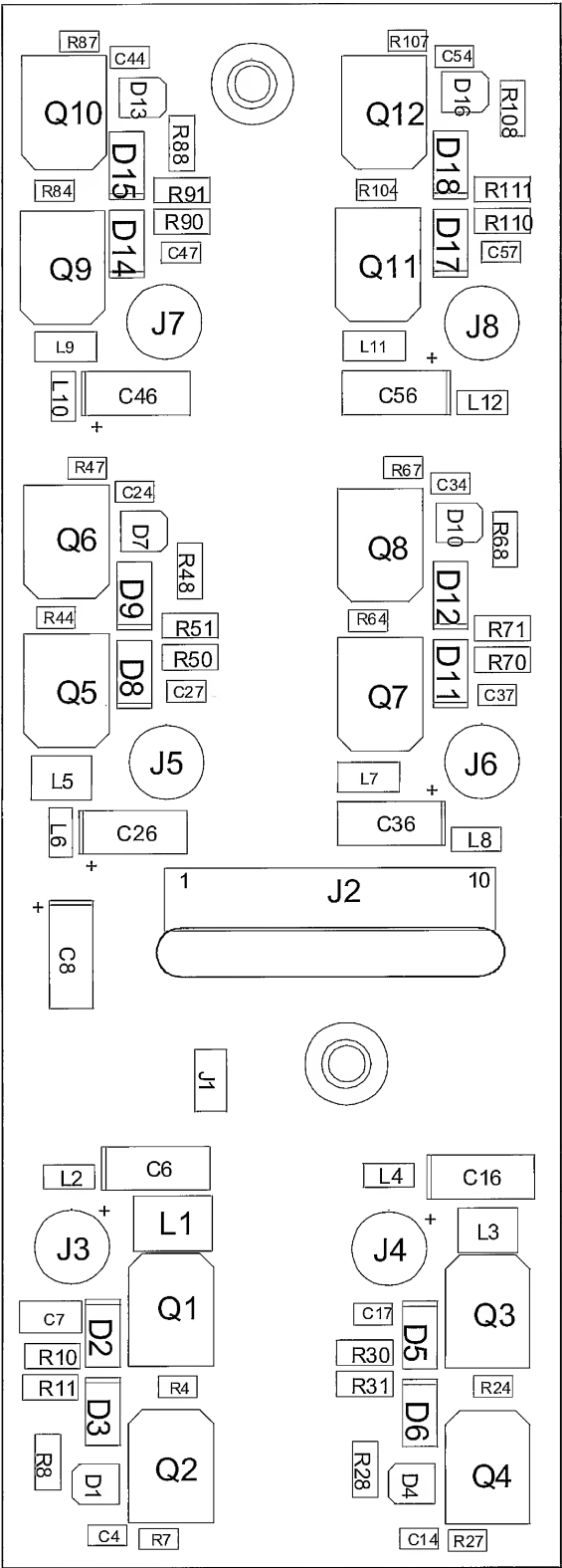
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|-----|---|------------------|
| R23 | RESISTOR 3.30kohm 1% .125W 100PPM 1206 | 4822 051 53302 S |
| R24 | RESISTOR 47 ohm 1% 0.1W 100PPM 0805 | 5322 117 12505 S |
| R25 | RESISTOR 5.60kohm 1% .125W 100PPM 1206 | 4822 051 10562 S |
| R26 | RESISTOR 1.50kohm 1% 0.125W 100PPM 1206 | 4822 051 51502 S |
| R27 | RESISTOR 47 ohm 1% 0.1W 100PPM 0805 | 5322 117 12505 S |
| R28 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R29 | RESISTOR 10.0 ohm 1% 0.125W 100PPM 1206 | 4822 051 10109 S |
| R3 | RESISTOR 3.30kohm 1% .125W 100PPM 1206 | 4822 051 53302 S |
| R30 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R31 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R4 | RESISTOR 47 ohm 1% 0.1W 100PPM 0805 | 5322 117 12505 S |
| R41 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R43 | RESISTOR 3.30kohm 1% .125W 100PPM 1206 | 4822 051 53302 S |
| R44 | RESISTOR 47 ohm 1% 0.1W 100PPM 0805 | 5322 117 12505 S |
| R45 | RESISTOR 5.60kohm 1% .125W 100PPM 1206 | 4822 051 10562 S |
| R46 | RESISTOR 1.50kohm 1% 0.125W 100PPM 1206 | 4822 051 51502 S |
| R47 | RESISTOR 47 ohm 1% 0.1W 100PPM 0805 | 5322 117 12505 S |
| R48 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R49 | RESISTOR 10.0 ohm 1% 0.125W 100PPM 1206 | 4822 051 10109 S |
| R5 | RESISTOR 5.60kohm 1% .125W 100PPM 1206 | 4822 051 10562 S |
| R50 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R51 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R6 | RESISTOR 1.50kohm 1% 0.125W 100PPM 1206 | 4822 051 51502 S |
| R61 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R63 | RESISTOR 3.30kohm 1% .125W 100PPM 1206 | 4822 051 53302 S |
| R64 | RESISTOR 47 ohm 1% 0.1W 100PPM 0805 | 5322 117 12505 S |
| R65 | RESISTOR 5.60kohm 1% .125W 100PPM 1206 | 4822 051 10562 S |
| R66 | RESISTOR 1.50kohm 1% 0.125W 100PPM 1206 | 4822 051 51502 S |
| R67 | RESISTOR 47 ohm 1% 0.1W 100PPM 0805 | 5322 117 12505 S |
| R68 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R69 | RESISTOR 10.0 ohm 1% 0.125W 100PPM 1206 | 4822 051 10109 S |
| R7 | RESISTOR 47 ohm 1% 0.1W 100PPM 0805 | 5322 117 12505 S |
| R70 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R71 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R8 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R81 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R83 | RESISTOR 3.30kohm 1% .125W 100PPM 1206 | 4822 051 53302 S |
| R84 | RESISTOR 47 ohm 1% 0.1W 100PPM 0805 | 5322 117 12505 S |
| R85 | RESISTOR 5.60kohm 1% .125W 100PPM 1206 | 4822 051 10562 S |
| R86 | RESISTOR 1.50kohm 1% 0.125W 100PPM 1206 | 4822 051 51502 S |
| R87 | RESISTOR 47 ohm 1% 0.1W 100PPM 0805 | 5322 117 12505 S |
| R88 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R89 | RESISTOR 10.0 ohm 1% 0.125W 100PPM 1206 | 4822 051 10109 S |
| R9 | RESISTOR 10.0 ohm 1% 0.125W 100PPM 1206 | 4822 051 10109 S |
| R90 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| R91 | RESISTOR 100 ohm 1% 0.125W 100PPM 1206 | 4822 051 51001 S |
| U1 | IC-CMOS 74HC390 SMD SO16 | 9337 147 20701 |
| U2 | IC PC74HC74T SO-14 | 5322 209 71589 |
| U3 | IC-CMOS PC74HC126T SMD SO14 | 5322 209 17393 |
| U4 | IC-CMOS PC74HC126T SMD SO14 | 5322 209 17393 S |

Schematic Diagrams (PM9671B)

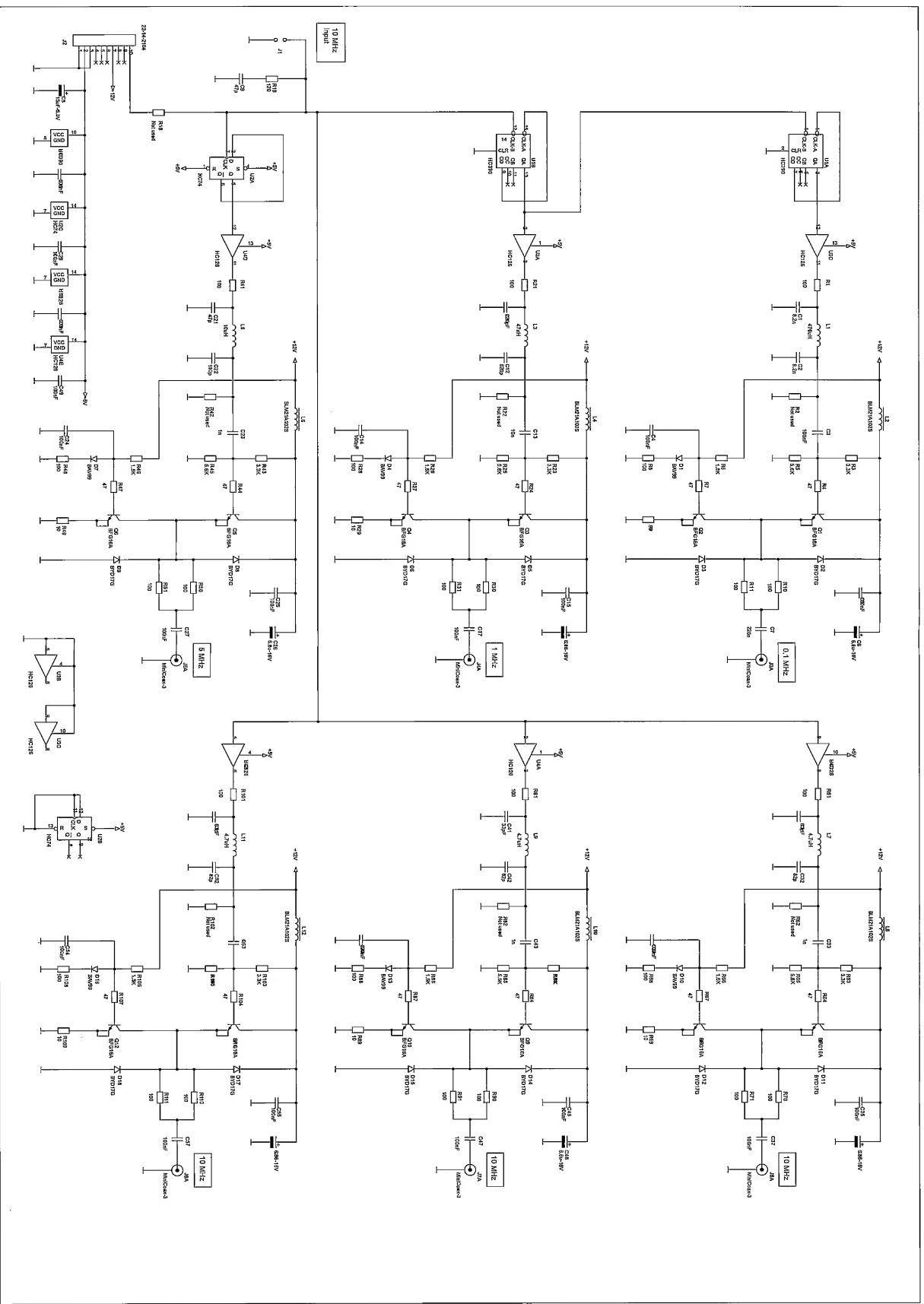
BOTTOM SIDE



TOP SIDE



PM6671B, Circuit Diagram



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Chapter 10

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